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THE COLLECTION AND ORGANIZATION OF FIELD MATERIALS: A RESEARCH REPORT[1]

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There appear to be relatively few sociological and anthropological monographs which throw any light on the process by which the student's experience in the field is transformed into his published statement.[2] And yet, since it is after all a man, and not some impersonal scientific apparatus, who makes the study; and since the student's subject matter, too, is man, however complexly abstracted he may be, it would seem exceedingly important that the student become aware of this process, examine it, and submit his findings to his readers.

I have tried to do so in a preliminary fashion (Wolff, 1951) in respect to my own experience in "Loma," a small, largely Spanish-speaking southwestern community, without going, however, into the actual operations which governed the collection and organization of field materials. To describe these operations—a task much more modest than the larger enterprise mentioned, though intimately related to it—is the purpose of the present paper, which contains only the briefest allusion to that more comprehensive enterprise, and only the briefest reference (in the last section) to the writing up of the materials gathered.

COLLECTION OF FIELD NOTES AND THEIR CLASSIFICATION BY TOPICS

In 1942, as an employee of the "Loma Institute," I made a house-to-house questionnaire survey of the community, largely for census-type information. I returned in 1944 as a Social Science Research Council fellow when, under the supervision of Professors Robert Redfield and Sol Tax, Department of Anthropology, The University of Chicago, I was to find out whether "culture patterns" could be established empirically so that another student could go back and check point by point. But eventually I came to find that I could not accept this assignment, because it presupposed a conceptualization of which I did not know whether it would be appropriate to my "Loma experience." Finally, I became skeptical

[1]Paper read at the Thirteenth Annual Meeting of the Ohio Valley Sociological Society, Bloomington, Indiana, 28 April 1951.

[2]Most of those I know—all of them anthropological—are referred to in Herskovits, 1948, Chapter 6, "The Ethnographer's Laboratory," in which the first pages (81–83) of Section 2 give an excellent example of the transformation of field experience into generalized statement. Among the references contained in that chapter, the most important ones are certain passages from M. J. and F. S. Herskovits, 1934; Malinowski, 1922 (the relevant section of which is reprinted under the title "How an Anthropologist Works" in Haring, 1949); Evans-Pritchard, 1940; and Mead, 1940. Cf. also Bateson, 1932 (esp. pp. 441–444), 1936 (especially Chapters I, VIII, XVI (also see some pertinent passages in Wolff, 1944), and 1941; and Mead, 1949, Chapter II. I plan to discuss these and similar materials in another paper.

of received notions as guides of research generally, and I advocated, instead, that in the field the student hold as many of these notions as possible in abeyance, and expect the organization and presentation of his materials to emerge in the study itself.

Although not all of this was clear to me in the first stages of my field work, it accounted—satisfactorily to me—for the fact that I had at once begun to observe and to record my observations, and without any attempt at order or selection. My field notes thus resembled a diary, expanding page by page, immediately typed from short notes, memory, or dictation. As writing accumulated, however, some sort of structuring became imperative: I proceeded to break down my notes

TABLE 1

*Classification of field notes by topics: Loma, 1944**

1. "Acceptance"	23. Food	45. Organization
2. Agriculture	24. (Gestures)	46. Politics
3. Anglo-Anglo Relations	25. Happiness	47. Population
4. Anglos re Anglos	26. Health	48. Race
5. Anglos re Spanish	27. History	49. Religion
6. Change	28. Hospitality	50. Self
7. Children	29. Houses	51. Shame
8. Clothing	30. Indian	52. Smoking
9. Community Organizations	31. Individuals, Anglo	53. (Sociology or Knowledge)
10. "Compañero"	32. Individuals, Spanish	54. Spanish-Anglo Relations
11. Cooperation	33. Informants	55. Spanish re Anglos
12. Correspondence	34. Investigator	56. Spanish re Spanish
13. Craft	35. Isolation	57. Spanish-Spanish Relations
14. Crime	36. Kinship and Genealogy	58. Status and Prestige
15. Death	37. Knowledge, Anglo	59. Time
16. Economics	38. Knowledge, Spanish	60. "To the Point"
17. Education	39. Language	61. Transportation
18. (Emotionality)	40. Life History	62. Visiting
19. Family	41. Mail	63. War
20. Farmers' Union	42. "Mañana"	64. Waste
21. Fear	43. Marriage	65. Water
22. Feudalism	44. Methodology	66. Weather

*Parentheses around the name of a topic indicate that field-note passages relevant to it can be found only under other topics. See discussion of " 'Also under' list" below.

by topics. I started with this only after having produced about 80 single-spaced pages of typescript; but once I had completed the classification (at a point when the pages had increased to approximately 140—I had continued to write down notes even while going on with the breakdown), I kept it up to date. From the beginning, I made two carbons of all notes, keeping the original as a running account, sending the first copy to Professor Redfield, at certain intervals, and using the second for clippings. I wrote the names of the topics on the margins, clipped the page or pages, and placed the clippings in envelopes, each bearing the name of the topic under which I classified a particular passage. There were thus as many envelopes as there were topics—66 (table 1).

EXPLANATIONS AND ILLUSTRATIONS OF SOME TOPICS

The meaning of some of these topics needs clarification. " 'Acceptance' " covers materials bearing on the unreflective acceptance of what comes or is—to illustrate:

> . . . when I stopped in at Pepina's . . . [she] said a nephew of hers . . . was "enfermo en la cabeza, tumor—muy triste [sick in the head, a tumor, very sad]"; he had been in Italy (which I had learned the day before), but now was in "Norte

> America"; what that was; I said it must be this country. Later Fay [an Anglo, that is, an English-speaking person] told me the Maeses [Pepina and her family] had just received a telegram from the War Department that he was seriously ill, cerebral tumor, was in the North American area . . . They had not indicated to me that they had just received the wire that morning. Silvia [Pepina's daughter] mentioned nothing about this yesterday after she had undoubtedly learned of it. (Loma field notes, p. 6; 5 May 1944.)

" 'Compañero' " refers to the habit of two or more persons to do things together (for instance, walking); "Correspondence," to letters, between various persons and myself, dealing with the Loma study; "Emotionality," to the affective channeling of experience; "Happiness," to its conceptions and criteria; "Indian," to Indians and things Indian; "Investigator," to evaluations, by Lomans, of myself or my activities; "Knowledge, Anglo" and "Knowledge, Spanish," to conceptions by English-speaking and Spanish-speaking individuals of miscellaneous phenomena. " 'Mañana' " labels particular attitudes toward the immediate present, as inferable from the following passage:

> When I'd just started typing the above, Alejandro came in with a bunch of herbs, sat down, murmured something about my being busy, but then started explaining [the herbs]. (*Ibid.*, p. 290; 23 July 1944.)

"Methodology" covers items concerning sociological methodology and theory. "Organization" refers to conceptions and practices of coordinating thoughts, activities, and persons—for instance:

> She [Pepina] said she went to see the doctor in Justino [county seat], but he was away for two weeks. (Re "Organization:" she made a trip, difficult for her, only to find that it was in vain, since she hadn't made sure before going whether the doctor was available. However, . . . the lack of organization is observed by me in terms of what we—members of "my" culture—think about organization. In other words, it is a lack of organization or of planning in terms of our, not their, culture. What is it in terms of their culture? The answer to this question could be approached only by "immanent interpretation," that is, by what Pepina herself says about this unsuccessful trip. The trouble is that she cannot interpret it. All she could . . . [interpret] she has already said: she went, and the doctor wasn't there, and that is too bad.) (*Ibid.*, pp. 337–338; 13 August 1944.)

"Race," "Self," "Shame," and "Time" comprise notes relevant to the conceptions of these phenomena. " 'To the Point' " refers to relations between immediate occasion and its possible implications—as reflected in this entry:

> This morning, Silvia, upon my question re the San Isidro service today, said that there wasn't going to be any; Mrs. Sanchez (in possession of the church keys) told her that Mrs. A. S. was in Justino and hadn't come back yet. So I asked about the significance of Mrs. A. S., and Silvia said she was "mayordoma de la iglesia [church stewardess]," which she hadn't told me yesterday. Gradually then I found out that there are always not two persons, as I had thought yesterday, but two couples who make the "mayordomos" . . . Tentatively stated, the "pattern" would be to give information only to the point, but not to think in terms of "complexes" or, better, "topics." (*Ibid.*, p. 47; 15 May 1944.)

Finally, "Waste" includes clippings describing handling and conceptions of waste materials.

CROSS-REFERENCING THE TOPICS

I provided the topics with a twofold index. Each envelope containing clippings relevant to a particular topic, carried, in addition to the name of that topic, two lists of others: (1) those for which some of the clippings contained in the envelope

were also relevant ("Also" list), and (2) those under which additional clippings relevant to the topic could also be found ("Also Under" list). An illustration:

> Carla [my wife] told me that when she remarked . . . that so many people die here, Silvia answered, "Nadie muere de enfermedad aquí [nobody dies of sickness here]!" Carla pointed to [young] David Armijo's death, but Silvia said this was pneumonia. I'll find out about this; perhaps it was only a reaction in terms of community pride to say that people here die only of old age (as Silvia elaborated); or it might—less likely—indicate belief in death causes other than sickness and old age. (*Ibid.*, p. 351; 15 August 1944.)

I classified this field-note clipping under "Death," but cross-referenced it, in the manner indicated, with the topic "Knowledge, Spanish." (Clippings, of course, varied greatly in length, from a line or two to several pages. On the whole, the longer they were, the more likely they would be relevant to topics in addition to the one under which they were classified.)

CLASSIFICATION OF TOPICS BY CATEGORIES

I thus brought back from the field 66 envelopes whose contents were made up of some 500 pages of typescript. When I tried to write up these materials,[3] the

TABLE 2

*Classification of topics by categories: Loma, 1944**

CATEGORY	TOPICS
1. Background Materials	Agriculture; Clothing; Craft; Food; History; Isolation; Population; Transportation; Water (16; 20; 26; 29; 36; 46; 49; 52; 63; 66)
2. Culture Change	Change (20; 22; 27; 63; 65)
3. Social Relations	Anglo-Anglo Relations; "Compañero"; Cooperation; Hospitality; Kinship and Genealogy; Mail; Spanish-Anglo Relations; Spanish-Spanish Relations; Visiting (4; 5; 55; 56)
4. Social Institutions	Children; Community Organizations; Crime; Economics; Education; Family; Farmers' Union; Houses; Language; Marriage; Politics; Smoking; Status and Prestige (22; 49)
5. Evaluations and/or Interpretations	Anglos re Anglos; Anglos re Spanish; Death; Fear; Feudalism; Happiness; Health; Indian; Individuals, Anglo; Individuals, Spanish; Informants; Investigator; Knowledge, Anglo; Knowledge, Spanish; Life History; Organization; Race; Religion; Self; Shame; Spanish re Anglos; Spanish re Spanish; Time; War; Waste; Weather (7; 17; 19; 28; 29; 35; 39; 58)
6. Clues to Patterns	"Acceptance"; Emotionality; Gestures; "Mañana"; "To the Point" (10; 21; 25; 28; 39; 41; 45; 50; 51; 59; 64)
7. Theory and Methodology	Correspondence; Methodology; Sociology of Knowledge (31; 32; 33; 34)

*Names of topics spelled out are of primary relevance, those indicated by numbers in parentheses, of secondary relevance, to the heading preceding them.

need for further classification became obvious. In other words, I found that I had to proceed in respect to the topics as I had in respect to the field notes: I had to arrange them under fewer and broader headings, of which there emerged seven: the six categories of "Background Materials," "Culture Change," "Social Relations," "Social Institutions," "Evaluations and/or Interpretations" (on the part of Lomans), and "Clues to Patterns;" and a seventh section on "Theory and

[3]The opportunity to do so was given me by grants from the Wenner-Gren Foundation for Anthropological Research, Inc. (then The Viking Fund, Inc.), and the Graduate School, The Ohio State University, in 1947 and 1949, to which institutions I gratefully acknowledge my indebtedness.

Methodology: Concluding," the latter corresponding to a similar introductory section. Furthermore, I found it useful to distinguish a primary and a secondary relevance which the topics had to these headings. In table 2, the names of the topics of primary relevance directly follow the name of the heading; those of secondary relevance follow afterward, listed by numbers in parentheses only. (For the identification of these numbers, see table 1.) Appendix A gives an inventory of all those topics, with their "Also" and "Also Under" lists, which are relevant to the first two categories (nos. 1 and 2 in table 2).

The definitions of the categories, too, which guided the classification of the topics are most concisely presented in tabular form (table 3). These definitions were tentative, for preliminary organizational purposes. As I began to write up my materials, the seven headings or categories themselves, however, seemed well suited to serve as titles of seven parts in which the study could be presented; and while drafting the first two of them—which is all I have completed thus far—I found no reason for questioning this expectation. In discussing the topics and their subsumption under the categories, I shall now limit myself to these first two, "Background Materials" and "Culture Change."

TABLE 3

Definitions of categories: Loma, 1944

CATEGORY	DEFINITION
1. Background Materials	Aspects of a culture which can be grasped as readily understood by the same means as they would be in the study of a culture very similar to that of the student*; those materials which strike the student as not presenting methodological problems**
2. Culture Change	Change in culture; presupposes, for its apperception, a conception of the culture under study as different, or as methodologically assumed to be different, from that of the student#
3. Social Relations	Relations between individuals as individuals and as members of groups
4. Social Institutions	Phenomena virtually composed of heterogeneous elements, but constituting units in the universe of discourse of the members of the culture under study##
5. Evaluations and/or Interpretations	Evaluations, conceptions, and/or interpretations of phenomena by the members of the culture under study
6. Clues to Patterns	Materials bearing on culture patterns.
7. Theory and Methodology	Materials used as current checks on formulations of uniformities and on other generalizations, and as sources of experimentation with scientific rule

*Cf. Wolff, 1945, p. 181b.
**Cf. a similar definition of "general" (as against "unique") in Wolff, 1948, p. 208.
#See discussion of "Culture Change" below.
##Cf. Wolff, 1950, p. 59, n. 3.

"BACKGROUND MATERIALS" AND "CULTURE CHANGE"

(1) The first, "Background Materials," is the only or primary place for the following topics: "Agriculture," "Clothing," "Craft," "Food," "History," "Isolation," "Population," "Transportation," and Water." This subsumption suggests the "factual" character of the information gathered under these labels. "Agriculture" deals with the kinds, cultivation, and history of crops, with sharecropping, tenancy, marketing, and the like—the latter items also classifiable under "Economics," a topic, however, which is to be found primarily under "Social Institutions" and only secondarily here, under "Background Materials—#16 (figures refer to numbers in parentheses in table 2). "Clothing" describes what which

people wear and where they buy it, but also contains materials giving clues to "Evaluations and/or Interpretations" of clothing. "Craft" deals with crafts and skills practiced in Loma, but is also relevant to "Culture Change." "Food" treats dietary and culinary items, but also indicates changes in food habits, as well as Spanish-Anglo and Indian-Spanish relations in respect to foodstuffs, recipes, and relevant nomenclature. "History" is largely a chronological concept, but also covers data bearing on "Culture Change"; hence it is listed under that category too—#27. "Isolation" functions as an element in the "physical aspects" of the community, but the label also describes the influence of this element on people; therefore it also appears (#35) under "Evaluations and/or Interpretations." "Population" refers to the customary statistical conception. "Transportation" and "Water" are descriptive; under the latter topic, however (cf. the case of "Isolation"), there are materials on reactions to the water situation and on ideas concerning its improvement; hence "Water" also figures under "Culture Change" (#65).

The topics covering materials that are of secondary relevance as "Background Materials" (cf. the numbers in parentheses in table 2) are "Economics" (#16), "Farmers' Union" (#20), "Health" (#26), "Houses" (#29), "Kinship and Genealogy" (#36), "Politics" (#46), "Religion" (#49), "Smoking" (#52), "War" (#63), and "Weather" (#66). That is, the primary relevance of these topics is with reference to other categories (as is likewise shown in table 2). Some of the aspects of them which are important here, in regard to "Background Materials," are: in the case of "Economics": income, property, wagework; in the case of "Farmers' Union": its history, activities, membership; of "Health": disease statistics, mortality, therapies; of "Houses": structure and equipment; of "Kinship and Genealogy": kinship terms, overt kinship behavior, genealogy; of "Politics": Loman office-holders, especially in the county, election procedures, and other "mechanics"; of "Religion": the church and the cemetery, church membership and attendance, religious societies; of "Smoking": usage and extent; of "War": its bearing on population changes; and of "Weather": metereological data.

(2) When I looked at the topics under "Culture Change," I was struck by the fact that I had listed only one topic, "Change" itself, as of primary relevance, and only five others as of secondary relevance, to this category. On the other hand, I realized that almost all topics contained some information on how "it" used to be as compared with how "it" is now. Thus instead of asking myself why there were no *more* topics under "Culture Change," I soon wondered why I had set aside any at all here. The answer I came to find was that I had been guided in my arrangement by a conception of the culture under study as different, or as methodologically assumed by me to be different, from my own. That is to say: changes in the cultivation of crops, clothing, craft, population, transportation, or the water system were dealt with under "Agriculture" and other topics relevant to "Background Materials," whereas "Culture Change" covered these changes as viewed by the Lomans and thus as challenging the student to an interpretation of this view. It was such materials which I must have set aside under the special topic "Change"; and such materials are also contained under the topics listed as of secondary relevance to "Culture Change": "Farmers' Union" (#20), "Feudalism" (#22), "History" (#27), "War" (#63), and "Water" (#65). While "Change" contains materials recording conversations with individuals who had undergone culture change, that is, who had changed in their evaluations, conceptions, and goals, "Farmers' Union" covers data concerning an imported institution which modified the outlook of certain Lomans on agriculture, education, government, community organization, and the like; "Feudalism" is significant as a label for clues to an earlier social system and to its present-day traces; "History," mainly, as a depiction of factual changes in terms of which changes in a more interpretive sense may be understood; "War," as affecting changes in the cognitive, emotional,

and moral horizons (in the knowledge of geography and, to some extent, of history; in the preoccupation with family members in the services; in identification with the fate of the nation; and so forth); and "Water," as illustrating efforts to improve the agricultural and economic situation, thus indicating changes in attitudes toward nature, in the direction of greater initiative and organization.

The exposition of "Background Materials" and "Culture Change" is summarized in table 4, in which only the topics which are of primary or secondary relevance to these first two categories (21 out of the 66) are contained.

TABLE 4

*Description of topics in terms of their primary ("P") and secondary ("S") relevance to "Background Materials" and "Culture Change": Loma, 1944**

	Topic	Background Materials	Culture Change
2.	Agriculture	Crops, share-cropping, marketing: P	
6.	Change		Changes in Culture: P
8.	Clothing	Who wears what: P	
13.	Craft	Crafts and skills: P	
16.	Economics	Income, property, wage-work: S	
20.	Farmers' Union	History, activities: S	Change in agricultural outlook: S
22.	Feudalism		Past vs. present social system: S
23.	Food	Who eats what: P	
26.	Health	Health statistics: S	
27.	History	History: P	Material and broader changes: S
29.	Houses	Structure: S	
35.	Isolation	Element in physical aspects of culture: P	
36.	Kinship and Genealogy	Kinship terms: S	
46.	Politics	Office holders, procedures, mechanics: S	
47.	Population	Statistical category: P	
49.	Religion	Church, cemetery: S	
52.	Smoking	Usage and extent: S	
61.	Transportation	Transportation: P	
63.	War	Bearing on population changes: S	Bearing on intellectual, etc., horizon: S
65.	Water	Description of water situation: P	Changes in attitudes: S
66.	Weather	Metereological aspects: S	

*The relevance (primary or secondary) of these topics to categories other than "Background Materials" and "Cultural Change" is not indicated. Items listed under topics are not exhaustive, but only illustrative, most important, or typical.

WRITING UP THE MATERIALS

I conclude by mentioning an important problem which, along with others, forced me to rethink my procedure and my role in respect to the study of Loma. The problem resulted from the discrepancy between the utilization of my field notes as anticipated (and as detailed here), on the one hand, and on the other, their actual utilization when I wrote them up. I shall illustrate this discrepancy in regard to the part on "Culture Change," because I have committed myself to that part to the extent of having published a summary of it (though an extremely condensed one: Wolff, 1950). I found myself using, not so much the materials pertaining to the topics subsumed under "Culture Change," as only part of them and, in addition and above all, two types of other materials: life histories and

compositions by Loma school children. "Life History" (as an inspection of table 1 shows) was an original topic, but I had not listed it under "Culture Change," not even as of secondary relevance to it, but under "Evaluations and/or Interpretations" (cf. table 2). Furthermore, I utilized materials not contained in my field notes, and I had not taken the existence and importance of these materials into consideration when working on the organization of my data. Most significant among these materials were (1) life histories obtained by another person who spent several weeks in Loma in 1947,[4] and (2) the afore-mentioned school compositions which I had the local Spanish-speaking school children write in 1944 through the cooperation of the public-school teacher. I tried to make it clear to myself why I proceeded as I did even where I deviated from the earlier plan described here; and this clarification is reflected in the study itself. What I learned led me to write a new introduction (Wolff, 1951) in which I tried to analyze the process by which my experience in Loma was transformed into my objective statements, and to define my position regarding the "study of man" more generally; it also led me to make other changes in the text, especially in the "Background Materials." This mere announcement must suffice as the concluding point in my paper, in which I have presented one man's methodological operations and experiences, if only because they, too, are usually not exposed, and hence can only rarely be inspected.

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[4]After briefly acquainting herself with my 1944 field notes, Miss "Joan Pitt," then a graduate student in sociology at Ohio State University, spent approximately seven weeks in the field, under the joint supervision of Professor John W. Bennett, Division of Anthropology, Department of Sociology in the same institution, and myself. She was instructed to secure information on topics to which she, as a young, unmarried woman, would have more access than I had, a less young man with family. These matters mainly concerned children and related subjects; insight into them was to be obtained from girls of about Miss Pitt's age with whom it was hoped (rightly) she would establish friendly relations.

APPENDIX A

*Topics, with their "Also" and "Also Under" Lists, relevant to "Background Materials" and "Culture Change": Loma, 1944**

Topic	Also	Also Under
2. AGRICULTURE	"Acceptance" Anglos re Spanish Economics Hospitality Individuals, Anglo Knowledge, Spanish Methodology Spanish-Anglo Relations Spanish-Spanish Relations Transportation Water	Anglos re Spanish Crime Economics Family Happiness Individuals, Spanish Spanish-Anglo Relations Spanish-Spanish Relations Transportation
6. CHANGE	Economics Spanish-Spanish Relations Visiting	"Acceptance" Children Clothing Correspondence Craft Death Economics Family Farmers' Union Food Individuals, Spanish Kinship and Genealogy Knowledge, Spanish Language Marriage Politics Religion Water
8. CLOTHING	Change Children Time Weather	Crime Individuals, Spanish
13. CRAFT	"Acceptance" Change Death Economics Family Fear Hospitality Knowledge, Spanish Language Religion Spanish-Anglo Relations	Correspondence Economics Family Food Health Hospitality Houses Individuals, Spanish Knowledge, Spanish Religion Spanish-Anglo Relations Time Visiting

*"Topic" is the topic under which certain field-note passages are classified. The "Also" column lists topics for which certain field-note passages classified under the "Topic" are *also* relevant. The "Also Under" column is the reverse of the "Also" column: It lists topics *under which* field-note passages relevant to the "Topic" may *also* be found. Thus, some parts of field-note passages classified under "Agriculture" ("Topic") are "Also" relevant to " 'Acceptance,' " and some parts of field-note passages classified under "Anglos re Spanish" ("Also Under") also contain material relevant to "Agriculture."

APPENDIX A
(Continued)

TOPIC	ALSO	ALSO UNDER
16. ECONOMICS	"Acceptance" Agriculture Change Craft Crime Family Food Individuals, Spanish Language Mail Methodology Politics Spanish-Anglo Relations Spanish re Anglos Spanish re Spanish Status and Prestige Water	"Acceptance" Agriculture Anglo-Anglo Relations Anglos re Spanish Change Children Community Organizations Craft Death Family Farmers' Union Health Houses Individuals, Anglo Individuals, Spanish Life History Religion Time Transportation Water
20. FARMERS' UNION	Anglo-Anglo Relations Change Community Organizations Crime Economics Education Family Health Individuals, Anglo Individuals, Spanish Informants Language Marriage Organization Politics Race Spanish-Anglo Relations Spanish-Spanish Relations Time "To the Point" Visiting War Waste	
22. FEUDALISM	History	Health Spanish-Anglo Relations Spanish-Spanish Relations
23. FOOD	Change Children Craft Hospitality Kinship and Genealogy Knowledge, Spanish Language Race Spanish-Anglo Relations Visiting Weather	Correspondence Economics Knowledge, Spanish Language Methodology Religion Spanish-Anglo Relations Visiting

APPENDIX A
(Continued)

TOPIC	ALSO	ALSO UNDER
26. HEALTH	"Acceptance" Craft Economics Emotionality Family Feudalism Happiness Individuals, Spanish Isolation Kinship and Genealogy Knowledge, Spanish Language Methodology Organization Shame Spanish-Anglo Relations Spanish-Spanish Relations	"Acceptance" Anglos re Spanish Children Family Farmers' Union Individuals, Anglo Individuals, Spanish Knowledge, Spanish Language Religion Self Spanish-Anglo Relations Visiting War Water
27. HISTORY	Indian Knowledge, Spanish Language Population Spanish-Anglo Relations	Correspondence Feudalism Language Politics Spanish-Anglo Relations Spanish-Spanish Relations
29. HOUSES	Craft Economics Indian Knowledge, Spanish Spanish-Anglo Relations Transportation	"Acceptance" Family Hospitality Individuals, Spanish Religion Spanish-Anglo Relations Time Weather
35. ISOLATION	Hospitality Individuals, Anglo Methodology Spanish-Anglo Relations	"Acceptance" Health Individuals, Anglo Transportation
36. KINSHIP AND GENEALOGY	Change Family Individuals, Spanish Knowledge, Spanish Language Marriage Methodology Religion Spanish-Spanish Relations Visiting	Correspondence Death Food Health Informants Marriage Religion Spanish-Anglo Relations Visiting
46. POLITICS	Change History Individuals, Spanish Investigator Knowledge, Spanish Language Religion Spanish-Anglo Relations Spanish re Spanish Spanish-Spanish Relations	Economics Farmers' Union Individuals, Anglo Individuals, Spanish Spanish-Anglo Relations Visiting Weather

APPENDIX A
(Continued)

	TOPIC	ALSO	ALSO UNDER
47.	POPULATION		History
49.	RELIGION	"Acceptance" Change Children "Compañero" Craft Economics Education Family Food Gestures Health Hospitality Houses Indian Individuals, Spanish Kinship and Genealogy Knowledge, Spanish Language Organization Spanish-Anglo Relations Spanish-Spanish Relations Status and Prestige Time Visiting	Anglos re Spanish Correspondence Death Informants Kinship and Genealogy Life History Politics Spanish-Anglo Relations Status and Prestige Time "To the Point"
52.	SMOKING		Crime
61.	TRANSPORTATION	"Acceptance" Agriculture Cooperation Economics Family Hospitality Individuals, Anglo Isolation Knowledge, Anglo Mail Spanish-Anglo Relations Time Visiting War	Agriculture Houses Individuals, Spanish Spanish-Anglo Relations "To the Point"
63.	WAR	Health Knowledge, Anglo Mail	Anglos re Spanish Family Farmers' Union Individuals, Anglo Individuals, Spanish Language Spanish-Spanish Relations Transportation
65.	WATER	"Acceptance" Anglos re Spanish Change Cooperation Economics Fear Health Individuals, Anglo Sociology of Knowledge Spanish-Anglo Relations	Agriculture Economics

APPENDIX A
(Concluded)

TOPIC	ALSO	ALSO UNDER
66. WEATHER	Fear Houses Individuals, Spanish Informants Knowledge, Spanish Language Politics Spanish-Anglo Relations	Clothing Food Spanish-Anglo Relations

A CASE OF INTESTINAL MYIASIS BY *MUSCA DOMESTICA* IN A LABORATORY ASSISTANT

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Recently, infection of the alimentary tract by larvae of *Musca domestica* was detected, adding another case of this type to a long list already recorded in the literature. Riley and Johannsen (1938), Herms (1939), and Matheson (1950) report that cases of intestinal infection by maggots of this species are numerous, although this phenomenon is far from an everyday occurrence. The victim, doing post-graduate study and serving as laboratory assistant in the Department of Biology, suffered constant abdominal pain for three days. Other symptoms were nausea and irritability. After three days of self-treatment with Pepto-Bismol, the patient resorted to purging and after the fourth day, passed with the purged stool ten or more larvae which appeared non-motile and rather contracted. The larvae were identified as second instars of *Musca domestica*. In subsequent stools no additional larvae were observed.

The mode and source of infection in this case are not known with certainty although two possibilities have been considered. One possibility is that the victim, an avid cigar smoker, may have laid down his cigar with its moist end, somewhere in the laboratory, while working. Upon retrieving his cigar later he may have introduced fly ova deposited on the damp tip into his mouth. Adding to this possibility is the fact that the writer has been rearing flies in the laboratory for a research project. Occasionally they escape and are seen about the laboratory. The other possibility is that dishes of soft candy in the room of the victim's home may have stimulated the ovipositing instinct of a female fly.

Interestingly enough this is not the first experience of this kind for the victim. He reports that as a serviceman in 1944 on the South Pacific island of Emirau he passed fly larvae for three days, eventually being hospitalized. These larvae were large, possibly those of the calliphorid *Chrysomya megacephala*, a common form in the South Pacific.

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EIGHTY YEARS OF WEATHER AND CLIMATE AT TOLEDO, OHIO

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Many years ago on a small 40-acre farm in Wood County, two brothers, Emil and Guido Marx, had completed a hard day's work in the field setting out tomato plants. During the course of the evening, with a sharp drop in temperature after a bright sunny day, both were concerned as to whether a frost would ruin the labors of the day. Guido, the younger, stated, "Frost in May seems impossible, but this lake country is queer." After a few moments hesitation he added, "Wouldn't it be wonderful if some scientist could discover some way to predict the weather? Think of the crops it would save." Emil accused his brother of fanciful dreaming and wanting some sort of assistance through witchcraft or a sorcerer to gain this end, but Guido was insistent that if he were a scientist he would work on it in order to save crops and labor. He went on to state, "I predict in 10 years someone will do it."

The next morning the brothers ruefully surveyed the field they had so laboriously planted the preceding day. A heavy white frost covered the field and the precious tomato plants were flat. Guido stifled an oath. "All our hard work gone for nothing," he said bitterly. Emil shrugged his shoulders and replied, "It has always been the lot of the farmer." "But it shouldn't be" Guido replied angrily, "Someone should discover something."

The little story related above took place about 100 years ago. Since then much progress has been made in weather study and weather forecasting, so that today the young weather scientist not only studies the conditions of the weather at the earth's surface but is able to study the upper atmosphere, two to six miles above the earth. With such knowledge he has been able to make daily forecasts of 24 to 36 hours with considerable accuracy for some time, but now come the 30-day forecasts.

The work of these forecasts was begun in 1941 and first was the basis for 5-day forecasts. The next year some 30-day outlook maps were started, but were not more than in the experimental stage. In February 1950 the first written forecasts appeared. The Associated Press, in reviewing these 30-day written forecasts, states that out of 57 statements made by the weatherman, 45 seemed reasonably accurate when the forecast was compared with what actually occurred. This would prove to be about 80 percent accurate.

The 30-day forecasts differ from the daily forecasts in several important ways. Weathermen do not call them forecasts but rather 30-day outlook summaries. The long-range summaries use only general terms. However, accompanying maps sharply define the areas to which the weatherman is referring. The summaries do not forecast individual storms, nor do they apply to a particular place, like a community, but for the whole nation or large regions. They are based on the atmospheric pattern over a large portion of the earth at from two to six miles high. They predict what effect this slow-moving pattern will have on a large portion of the earth up to 30 days later.

Predictions have been made long enough in advance to give groups of people time to prepare for changes in temperature, rainfall and other weather elements. Coal dealers, overcoat merchants and dealers in summer clothes and electric fans are thus able to time their advertising to meet the anticipated change. Farmers also have been helped in being forewarned in caring for crops and livestock during critical periods. Such progress is possible only after years of weather study with

efficient instruments and a development of techniques. Observations used in this study, secured from weather bureau files, cover a period of 80 years beginning with the data of 1871 and including 1950.

LOCATION

Toledo, Ohio is located in the northwestern part of the state at the extreme western end of Lake Erie. It lies approximately 42° N. Lat. and 84° W. Long. well within the belt of prevailing westerlies. It is exposed in all directions as it lies on an extensive plain with no protective physical features. Southward from Toledo lies the floor of post-glacial Lake Maumee at an elevation of 600 feet. To the westward the city lies upon some low beach ridges and sand dunes at elevations slightly over 620 feet. The Maumee River empties into Lake Erie here and divides the city into two parts so that much of it lies but a few feet above the 570-foot level of Lake Erie.

Observations and the recording of weather data have been made at various locations within the city during the years considered. The office quarters were

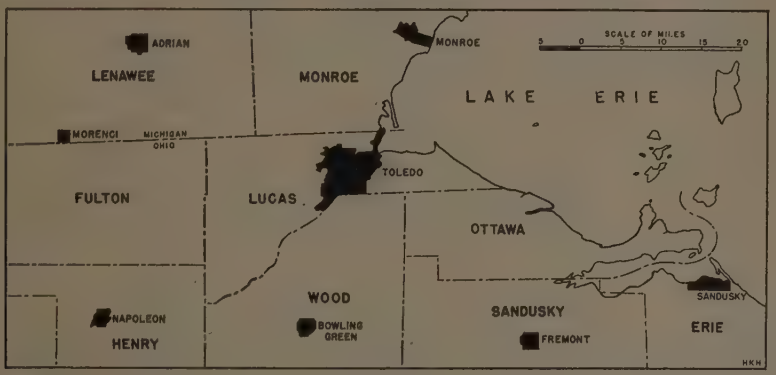

FIGURE 1. Location of Toledo, Ohio, and surrounding cities of Ohio and Michigan with respect to Lake Erie.

first maintained on the first floor of a building near Water Street and Madison Avenue from November 1, 1870, to March 1, 1871. Following the latter date until February 1, 1888, they were in the Chamber of Commerce Building on Summit Street and Madison Avenue. Other locations include: the Government Building, Madison Avenue and St. Clair Street, from February 1, 1888, to July 11, 1906; in the Nicholas Building, Madison Avenue and Huron Street, from July 11, 1906, to June 20, 1932; and in the new Federal Building on Civic Center, near Spielbusch Avenue, from June 20, 1932, to date. On February 1, 1943, instrumental records were made official at Toledo Muncipal Airport near Moline, Ohio (about 6 miles southeast of the city) and continue there. Since February 1, 1943, some comparative and climatological records are being made at the city office for the city area.

LAKE INFLUENCES

Toledo's location at the western end of Lake Erie places it in a position so that marine influences are felt. Figure 1 shows the geographical position of Toledo and surrounding cities with respect to Lake Erie. All are within a radius of 50 miles from Toledo and all within 40 miles of Lake Erie. From figure 1 it will be seen that Toledo and Monroe lie along the western edge of the Lake while Sandusky lies along the southern edge about 45 miles east of Toledo. The other five cities lie from 15 to 40 miles away from the edge of the Lake.

Two distinct types of climate may be observed between these two groups of cities. Along the edge of the Lake a semimarine type prevails changing to a continental with increasing distance from the Lake. The semimarine type is governed by the force and direction of the wind. When there is little or no wind, the weather becomes continental in character, which means pronounced fluctuation in temperature—hot weather in summer and severe cold in winter. On the other hand, a strong wind from the Lake may immediately transform the weather into a semimarine type.

Data for the selected cities, which were picked at random in order that a group of cities encircle Toledo, may be observed in table 1. These records cover a period of 38–40 years with the exception of Morenci and Monroe, Michigan, which are for a much shorter period. The maximum temperatures of 105° F for Toledo and Sandusky and 106° F for Monroe are slightly lower than those for the other cities, while the minima of −16° F at Toledo and Sandusky and −17° F at Fremont are several degrees higher than the minima for the other cities.

TABLE 1*

CLIMATIC SUMMARY

	Temperature					Killing Frost Average Dates			
	Length of Record	January Average	July Average	Maximum	Minimum	Length of Record	Last in Spring	First in Fall	Growing Season
	Yr.	°F	°F	°F	°F	Yr.			Days
Toledo, Ohio	40	26.9	74.0	105	—16	40	Apr. 20	Oct. 22	185
Sandusky, Ohio	40	27.9	74.0	105	—16	40	Apr. 17	Oct. 28	194
Fremont, Ohio	38	27.1	74.1	110	—17	38	May 1	Oct. 16	168
Bowling Green, Ohio	40	26.6	73.4	110	—22	39	May 7	Oct. 12	158
Napoleon, Ohio.....	40	26.5	73.6	110	—22	37	May 4	Oct. 13	162
Morenci, Michigan	30	25.5	73.5	109	—28	32	May 9	Oct. 5	149
Adrian, Michigan	39	25.3	73.8	108	—26	38	May 6	Oct. 12	159
Monroe, Michigan	22	26.4	73.9	106	—21	22	May 7	Oct. 13	159

* Fisher (1941), Wills (1941).

A similar influence may be seen in the average dates of the last killing frost in spring and the first killing frost in fall. The average date of the last killing frost in spring is from 10 to 22 days earlier at Toledo and Sandusky than at the other cities. Similarly in the fall the first killing frost at Toledo and Sandusky comes from 6 to 23 days later than at the inland cities. Since large bodies of water are less responsive to temperature changes, Lake Erie holds the winter cold longer in spring and the summer heat longer in the fall than the inland areas. This stabilizing influence tends to retard the advance of the spring along its shores, thus holding back the development of vegetation till the likelihood of frost is over. In the fall a reverse process slows up the approach of cold weather till vegetation has matured and is safe from frost. As long as the wind is onshore in the lake areas, the effect is to temper the extremes of heat and cold, thus producing a more equable climate.

Table 1 also shows that the average growing season near the Lake ranges from 159 days at Monroe to 194 days at Sandusky. The growing season at Toledo averages 185 days; the longest was 224 days in 1910, and the shortest 132 days in 1895. The average date of the last freezing temperature in spring is April 21. The date of the last killing frost averages about April 23 and the last light frost

about May 14. On the average the first frost in fall occurs on September 27, the first killing frost on October 17, and the first freezing temperature on October 25. The data of Monroe, Michigan, seem to be entirely out of line with Toledo and Sandusky data in this and in other instances. A personal letter from Mr. A. H. Eichmeier, Meteorologist of the United States Weather Bureau station, East Lansing, Michigan has this to say, "Probably the reason for the shorter growing season listed at Monroe is because of the fact that it is a cooperative station and usually at cooperative stations it is necessary to use the last freezing temperature in the spring and first freezing temperature in the fall as observers frequently do not mention frost data, while at first order stations a temperature as low as 27 or 28 might be required before actual killing frost was registered. Also, the record for Monroe is of short duration." The growing season at the insland cities ranges from 149 days at Morenci to 168 days at Fremont. The extreme range in the length of the growing season between the two groups of cities is from 10 to 45 days.

TEMPERATURE

Further temperature conditions may be observed from figure 2 which charts both temperature and precipitation data. The three lines in this graph represent temperature distribution throughout the year. The middle line shows the mean monthly temperature (also see table 2, column 1) to vary from a low of 26.5° F

TABLE 2#

TEMPERATURE DATA: MEANS AND EXTREMES
(Length of Record—77 Years)

	Mean Monthly	Daily Maximum	Monthly Maximum	Year	Record Highest	Year	Daily Minimum	Monthly Minimum	Year	Record Lowest	Year
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
January	26.5	33.5	40.2	1880	71	1890*	19.5	13.7	1918	—16	1897
February	27.1	34.4	39.4	1882	71	1944	19.8	17.0	1875*	—16	1885
March	35.9	43.9	47.7	1945	83	1910	28.0	27.7	1885	—10	1948
April	47.4	56.1	55.2	1878	89	1915*	38.6	39.6	1874	12	1875
May	59.1	68.3	67.4	1911	95	1911	49.9	52.2	1907	28	1945
June	69.0	78.1	75.4	1933	101	1934	59.9	63.4	1903	38	1929
July	73.6	82.9	79.0	1921	105	1936	64.2	68.0	1891	44	1945
August	71.4	80.5	77.2	1947	103	1918	62.2	66.6	1927	41	1946
September	64.7	73.8	72.4	1881	100	1939	55.7	57.6	1918	29	1942
October	53.3	61.9	61.2	1879	92	1939	44.7	44.8	1925	21	1887
November	40.4	47.6	48.9	1931	80	1950	33.6	33.7	1872	2	1947
December	29.9	36.5	41.4	1889	70	1889	23.8	20.6	1872	—15	1872
Year	49.9	58.1	53.6*	1921	105	July 1936	41.7	46.4	1875	—16	Feb. 1885*

*Also on later dates, months or years. # Coleman (1950).

in January to a high of 73.6° F in July producing a mean temperature range of 47.1° F. The other two lines show the mean daily maximum and the mean daily minimum, the values of which may be seen in columns 2 and 7 respectively of table 2. The mean annual temperature of Toledo is 49.9° F.

Most people are interested in extremes of weather and rightly so; temperature extremes are no exception. The highest temperature ever recorded occurred on July 14, 1936, when a reading of 105° F was registered. The hot spell began on

July 8 and was not broken until July 15. This was not a local condition but the whole country was in its grip. When the heat wave ended, 55 people in the city of Toledo had lost their lives in one way or another attributed to the heat. The total number of heat prostrations was never known since many cases were treated by private physicians and were not reported. Damage reported on streets and

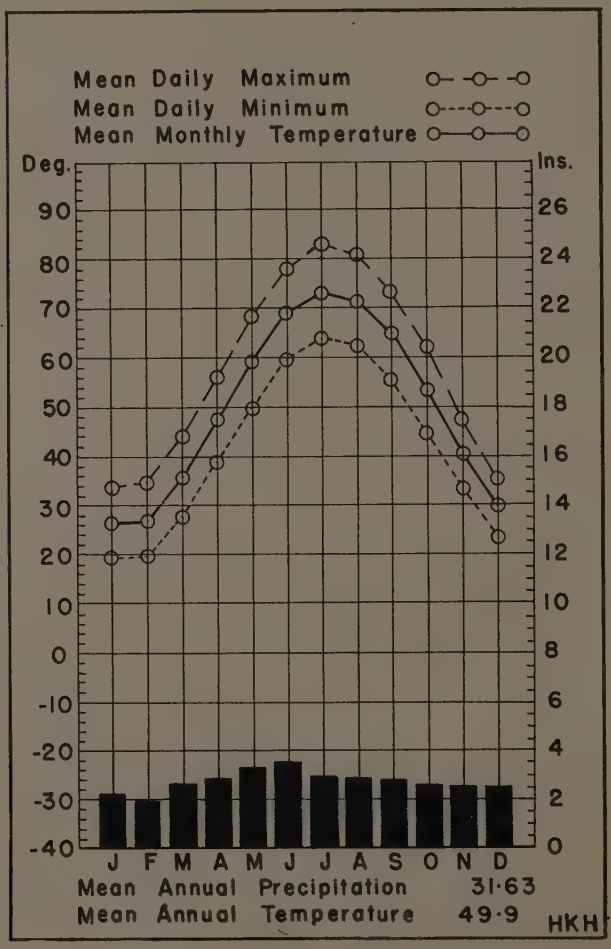

FIGURE 2. Climatic graph and statistics.

highways came from all parts of the city where brick and concrete had been used. On Monroe Street, four miles west of Toledo, the pavement exploded tossing concrete slabs into the air.

The lowest official reading of −16° F on February 11, 1885, and again on January 25, 1897, gives the city an absolute range of 121° F. The temperature drop was gradual over a four-day period before the minimum was reached on

January 25. On the East Side, the mercury stood at −18° F unofficially and at Lawrence Avenue Drug Store it registered −22° F. Although much suffering was reported throughout the city, many were made happy due to the intense cold. The dealers in ice anticipated almost any thickness of ice desired for the next summer's trade. Orders were poured in to the coal dealers throughout the morning and thousands of tons of coal were delivered before the end of the day's business. Other merchants were made happy because the extreme cold created wants that had to be supplied by them. Street cars ran on fairly regular schedules but conductors and motormen suffered with the cold. The conductors did not all

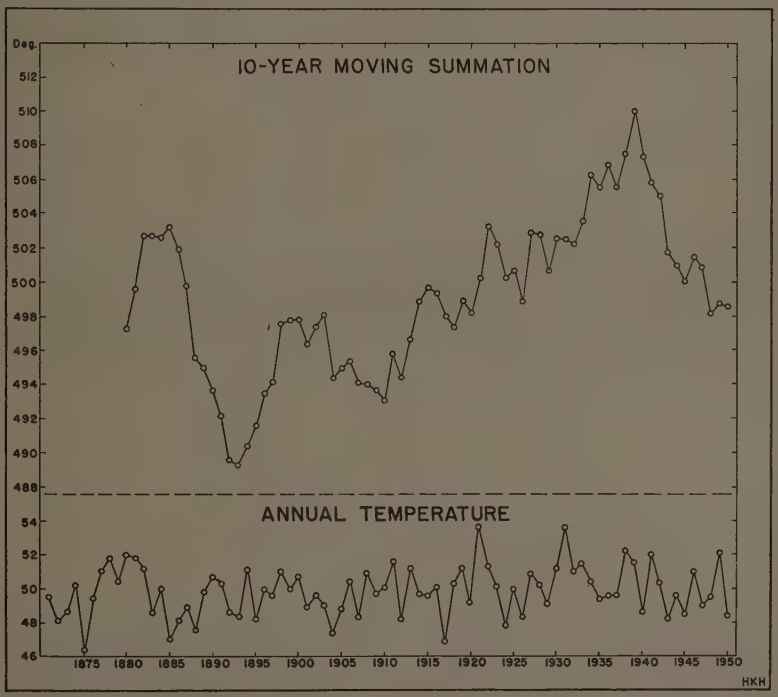

FIGURE 3. The mean annual temperatures at Toledo, Ohio, in the lower portion of graph. The sum of a 10-year period represented by each point in the upper portion of graph.

adhere to the orders to keep on the rear platforms on long runs, but common sense taught them to go inside where many spent an unusual amount of time stirring up the fires in the stoves. The motorman, whose duties would not permit this, got the worst of it.

On the average there are only eleven days a year when the temperature reaches 90° F or higher, and five days when it drops to 0° F or lower. Other temperature data may be seen by further consultation of table 2.

Figure 3 graphically presents the mean annual temperatures throughout the period of observation. This will be observed in the lower portion of the chart. The mean annual temperature of 49.9° F has been exceeded many times and has not been reached almost an equal number of times during these 80 years. Six years have a mean temperature above 52° F and a like number below 48° F. The two

years with the highest mean annual temperature of 53.6° F were 1921 and 1931. The two coldest years were 1875, with a mean annual temperature of 46.4° F, and 1916 with one of 46.9° F.

The upper portion of this chart is an attempt to show a trend in temperature. The mean annual temperatures of 10 consecutive years are used in plotting each point in this moving summation. A medium high point was reached in 1885 with the maximum high in 1939. A low point occurred in 1893 with a trend toward another at the present time. One marked irregularity follows the low of 1893, between the years of 1895 and 1904, which is shown in the annual temperatures (lower portion of fig. 3) with a number of these years above the normal of 49.9° F and others but slightly under the normal. This chart shows a rather irregular upward trend from 1893 to 1939, a period of 46 years. The two high points are 54 years apart.

Fuel dealers and their patrons have an intense interest in degree days of heating but on a very different basis; the former on expanding his sales, and the latter in reducing his purchases. To those unfamiliar with the use of the term, a word of explanation is in order. Artificial heating is based on a daily mean temperature of 65° F. If the daily mean drops below this temperature, heating is necessary to keep a comfortable inside temperature. This difference (65° F minus each day's mean) is called number of *degree days*. Table 3 gives the cumulated degree days for each month of the year.

TABLE 3#

MEAN DEGREE DAYS OF HEATING
(Length of Record—77 Years)

January	1193	July	6
February	1070	August	15
March	900	September	107
April	534	October	377
May	230	November	729
June	45	December	1084
	Year	6290	

#Coleman (1950).

PRECIPITATION

Figure 2 also shows the normal distribution of precipitation throughout the year. The general trend is typical of the humid continental type and is characterized normally by abundant precipitation well distributed seasonally and from year to year with serious droughts of infrequent occurrence. The mean annual precipitation is 31.63 inches with a mean June maximum of 3.44 inches and a mean February minimum of 1.95 inches. Other mean monthly values appear in table 4, column 1. This seasonal march shows the summer to have about one and one-half inches more than the winter, the heavier amounts in summer being due to thunderstorms.

The annual precipitation is shown graphically in the lower portion of figure 4. During the 80-year period the annual precipitation has exceeded the average or normal of 31.63 inches 41 times, or 51.25 percent of the time, while it dropped under that average 39 times or 48.75 percent of the time. Figure 5 shows this relationship. This figure shows that there were eight years that the precipitation was five inches or more above normal; four years, more than 10 inches and one year, 1950, over 15 inches above normal. It also reveals that subnormal precipitation of five inches or more occurred 12 times, one year being more than 10 inches below normal. The precipitation has been five inches or more above the normal

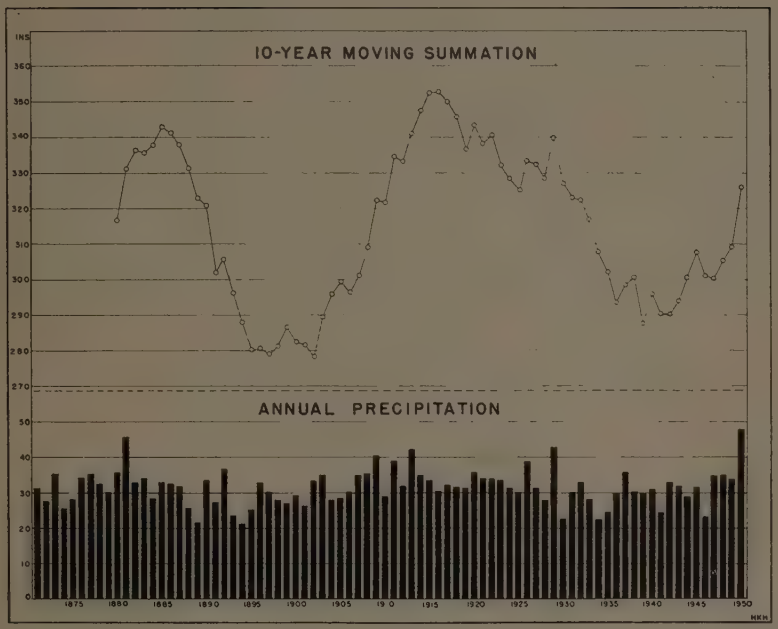

FIGURE 4. The annual precipitation at Toledo, Ohio, in the lower portion of graph. The sum of a 10-year period represented by each point in the upper portion of graph.

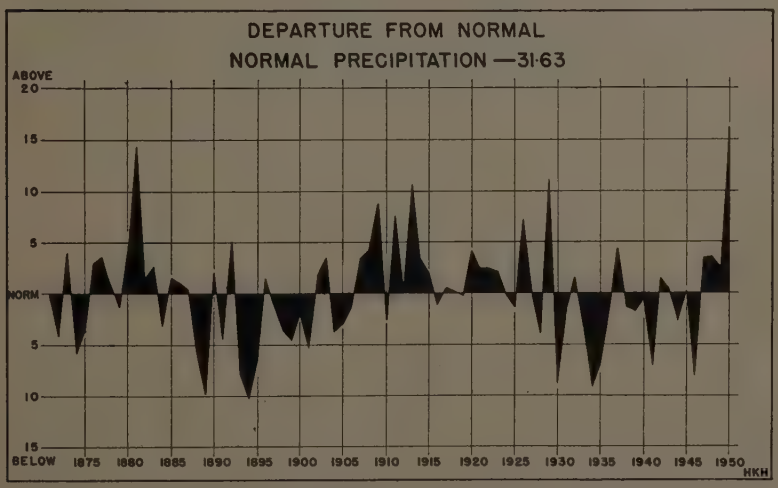

FIGURE 5. Chart showing the departure from the normal precipitation of 31.63 inches (1871–1950).

10 percent of the time and 15 percent of the time it has been five inches or more below normal. This is further evidence of a statement made earlier in this paper, that the precipitation of Toledo does not fluctuate greatly from year to year.

The upper portion of figure 4 is a 10-year moving summation on precipitation with the first point representing the years 1871–1880 inclusive. The general trend between the years 1880–1885 is upward with a maximum being reached in 1885. This corresponds with the moving summation in temperature which reached a peak the same year. During the next 10 years the trend is downward, then leveling off for seven years reaching a low in 1902. The drop during the 10-year period is similar to the drop in temperature but here the similarity ends. Temperature trends are already upward before the precipitation trend has reached its lowest point. By 1902, the time the moving summation reached the lowest point in precipitation, the temperature trend had already recovered more than half that which was lost following the year 1885. From this time on, 1902–1916, the moving

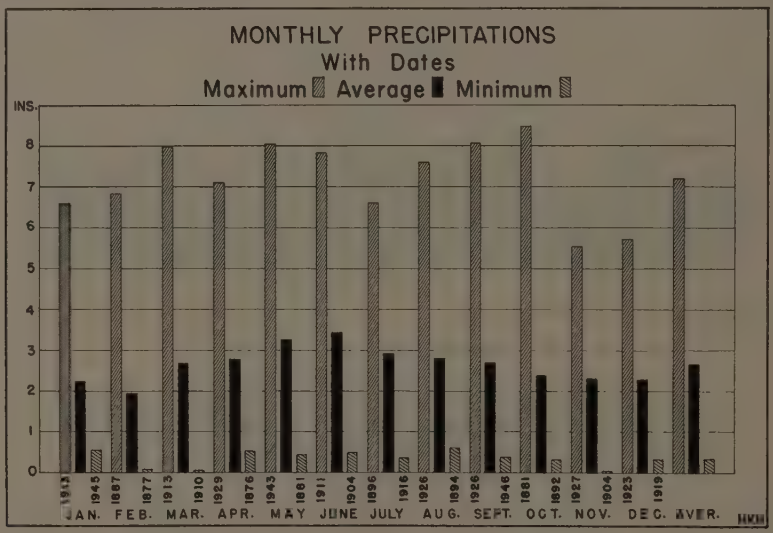

FIGURE 6. Monthly extremes of precipitation compared to the average with date of each.

summation in precipitation had reached its highest point while the temperature summation had changed but little. Between 1916–1939 the general trend in precipitation had been downward reaching its lowest point in 1939; the temperature trend continued upward reaching its highest point the same year. From 1939 to the present, precipitation trends have been upward and temperature trends downward.

Apparently very little in the way of correlation can be made of such trends. The trends which began contrary to the usual relationship between temperature and precipitation has ended quite favorably. Would it be in order to assume that precipitation would occur if the air masses contain sufficient moisture with a general drop in temperature? It would be interesting to make other comparisons in this general region to note whether the same relationship exists between temperature and precipitation as at Toledo.

Figure 6 shows that the difference between the wettest and driest months on record is considerable. The precipitation for the wettest months has varied as

much as 13 to 160 times the minimum with the greatest difference occurring in March. Figure 6 shows that every month of the year with the exception of November and December has had at one time precipitation amounting to six inches or more with three months having had over eight inches. The minimum amount is shown to be less than one-half inch for all months at some time except for the months of January and August. The normal monthly precipitation is shown by the black vertical bars in figure 6 and can be readily compared with the maximum and minimum amounts.

The monthly totals of precipitation of one inch or less (a very dry condition) have occurred the following number of times during the period of observation: January, 12; February, 18; March, 4; April, 7; May, 5; June, 3; July, 8; August, 6; September, 11; October, 11; November, 10; December, 9. Thus February is not only the driest month but also has occurred the greatest number of times with a precipitation of one inch or less during this period, an average of one about every four years. The other late summer and winter months also show a dry month every 10 to 12 years.

In spite of the fact that February is the month with the least mean precipitation and the month occurring the greatest number of times with a precipitation of one inch or less, it is not the month with the least ever reported. Table 4, columns 6 and 7, show minimum monthly precipitation and year of occurrence. It shows that two months, March and November, have had less with November, 1904, having had as little as 0.04 of an inch.

Monthly totals for precipitation of more than twice the expected, or average amount, have occurred the following number of times at Toledo during the 80-year period: January, 6; February, 8; March, 4; April, 3; May, 3; June, 2; July, 3; August, 7; September, 7; October, 3; November, 6; December, 3. All months doubled the expected on two or more occasions with June having the least with two, and February the most with eight. The maximum monthly precipitation of 8.49 inches fell in October, 1881. Other maximum monthly values and year of occurrence may be seen in table 4, columns 2 and 3.

Many heavy rains of short duration have fallen at Toledo during the period covered by this study, but two stand out above all others—the one of September 4, 1918, and of August 16, 1920. In the former, 5.98 inches of rain fell within a 24-hour period. This particular storm was not so intense as the latter, in which many new records were established for short periods of time; namely, 0.65 inches for five minutes, 1.25 inches for ten minutes, 1.78 inches for fifteen minutes, 2.87 inches for thirty minutes, 3.58 inches for one hour, 3.65 inches for two hours, and 3.70 inches for three hours. The maximum fall of 3.58 inches for one hour is a state record which has never been broken. The possibility of such severe downpours recurring is about once every 400 years (Sanderson, 1950).

The Toledo Blade of August 16, 1920, refers to this particular storm as follows, "A cloudburst broke over the city shortly after eight o'clock Monday morning and caused damage reaching into millions of dollars." Many of the downtown basements had six to eight feet of water in them and in some instances water was two feet deep for a short time on first floors of stores along Jefferson and Madison avenues. Here the loss was especially heavy as costly merchandise became water soaked or was floated away on the crest of the rushing waves. Jefferson Avenue from Huron to 14th Street was closed as thousands of wooden paving blocks were torn out and "gave the street the appearance of an Irish town after a Sinn Fein-Ulster argument." At the Great Lakes Towing Company office it was estimated that the current in the Maumee River was from five to eight miles an hour approaching the violence of a spring freshet. Three coal steamers which were ready to leave for upper lake ports failed to do so, not daring to attempt the swift current. In the Collingwood and Fulton Street areas, cellar walls began to collapse and thousands of basements were flooded in the west-end residences.

TABLE 4#

PRECIPITATION DATA: MEANS AND EXTREMES
(Length of Record—80 Years)

	(1) Mean Total	(2) Maximum Monthly	(3) Year	(4) Maximum in 24 hours	(5) Year	(6) Minimum Monthly	(7) Year	Snowfall, Sleet, Hail (66 years) (8) Mean Total	(9) Maximum Monthly	(10) Year	(11) Maximum in 24 hours	(12) Year
January	2.23	6.63	1913	1.56	1948	0.51	1945	7.5	26.2	1918	9.8	1885
February	1.95	6.84	1887	2.26	1883	0.08	1877	7.1	25.1	1900	19.0	1900
March	2.58	7.99	1913	2.69	1913	0.05	1910	4.9	17.1	1916	8.4	1888
April	2.78	7.13	1929	2.93	1929	0.55	1876	1.2	9.8	1886	9.0	1886
May	3.24	8.04	1943	3.57	1913	0.45	1881	0.9	4.0	1923	4.0	1923
June	3.44	7.86	1911	3.44	1944	0.51	1904	0.0	0.0		0.0	
July	2.91	6.65	1896	2.47	1929	0.35	1916	0.0	0.0		0.0	
August	2.80	7.64	1926	4.58	1920	0.60	1894	T	T	1949*	T	1949*
September	2.71	8.07	1926	5.98	1918	0.37	1946	T	T	1942*	T	1942*
October	2.38	8.49	1881	3.10	1881	0.32	1892	T	1.2	1925	1.1	1925
November	2.32	5.58	1927	2.68	1871	0.04	1904	1.9	12.0	1932	11.5	1932
December	2.29	5.74	1923	2.04	1885	0.33	1919	6.9	23.5	1895	10.8	1909
Year	31.63	8.49	Oct. 1881	5.98	Sept. 1918	0.04	Nov. 1904	29.8	26.2	Jan. 1918	19.0	Feb. 1900

* Also on later dates, months or years. # Coleman (1950).

SNOWFALL

Records of snowfall for Toledo which cover only a 66-year period have been tabulated for all months of the year excepting June and July (see table 4, columns 8–12 for snowfall data). Snows have been observed as late as May, with a maximum fall of four inches in 1923, and as early as August 1949 and 1950 when traces were reported. The average annual snowfall is 29.8 inches. Greater irregularity occurs with snowfall than with rainfall. Seasonal falls have varied from a minimum of six inches in 1889–1890 to a maximum of 63.7 inches in 1895–1896. December, January and February have had maximum monthly falls of over 23 inches. The heaviest fall occurred during the month of January, 1918 when 26.2 inches fell. There appears to be a tendency however, toward a slight general downward trend in total annual snowfall from the beginning of the century to the present time.

The maximum snowfall within any 24-hour period occurred on February 28, 1900, when a depth of 19 inches was measured. The Toledo Blade of this date reports that the snow began to fall a few minutes after midnight and continued to fall with but few interruptions until near noon on March 1. Fortunately the wind velocity was only eight miles an hour with a temperature of 20° F which did not permit much drifting of the heavy snow. The heaviest part of the storm was during February 28, between 7:00 A.M. and 7:00 P.M. when over 11 inches fell, but did not completely stop until 22 inches had fallen, a record for any single storm which still stands at Toledo.

The problem facing the street commission and other civil groups was a perplexing one. Over 100 extra men were employed to clear crossings in the downtown district and over 200 extra men were hired by the Consolidated Electric Company in an attempt to keep their lines open. The limiting factor was not so much one of men but of shovels and other tools which might be used for clearing purposes. Needless to say, trains and all traffic were delayed many hours and business in general was at a standstill. The only business that did not suffer because of the storm was the shoe stores. They were besieged for hours for overshoes and rubber boots, and available stock became the limiting factor here.

THUNDERSTORMS

Thunderstorms are most frequent during the summer months of the year when heat and moisture are abundant and light winds favor convection. The average number of days with thunderstorms is 35 each year. No month of the year is exempt from them although the number of thunderstorm days increases throughout the spring months reaching a maximum in June and July with an average of seven each, and decreasing throughout the late summer and fall months. Frequently high winds and heavy rains are incident to the passage of these storms.

A rather unique condition exists in relation to the winter thunderstorms which are not common at great distances from Toledo. Usually in early winter a few severe electrical disturbances occur caused by the relatively warm condition of the lower air over the water and the cooler upper air. These displays occur mostly in the latter half of the night when the temperature difference in the air masses is at its greatest.

WINDS

The location of Toledo in the belt of prevailing westerlies exposes it to the influence of winds from all directions and with varying velocities. This is especially marked during the winter when cyclonic storms are most active and wind conditions may change within the space of a few hours.

The prevailing wind direction, over a 70-year period, is from the southwest for all months of the year with a mean hourly speed of 11.3 miles. The highest mean hourly speed of 13.0 miles is reached in March followed closely by April, January, and February, respectively. Lighest winds occur in August with a

mean hourly speed of 8.9 miles. Data on the speed of wind in its fastest mile are not very reliable as records are only of seven years duration. These high velocities are reported largely from a westerly direction ranging from 38 miles per hour in July, 1946, to 87 miles per hour in March, 1948. Winds of very high velocities of tornado-like strength have passed through Toledo on earlier occasions. On March 28, 1921, a big wind swept through the city and nearby areas killing 20 persons, injuring over 80 and leaving more than 500 homeless. This twister was said to have been the most devasting since the one long ago that created Fallen Timbers along the Maumee.

SKY COVER

Figure 7 presents the condition of the sky between sunrise and sunset during the 80-year period. A series of four vertical bars are used for each month to indicate this condition on the basis of clear, partly cloudy, cloudy and average sky cover. December has the least sunshine and the greatest amount of cloudy skies with values of 16 and 58 percent respectively. Throughout the winter and the spring months the percentage of days with clear skies steadily increases reaching a maxi-

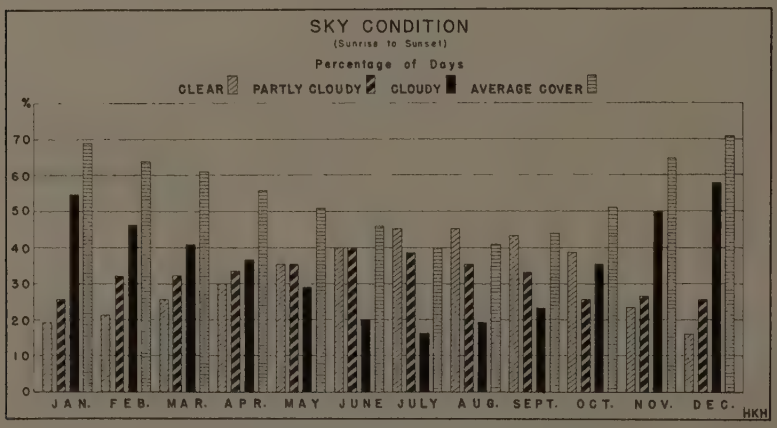

FIGURE 7. Monthly sky condition based on percentage of days Clear, Partly Cloudy, Cloudy, and Average Cover (1871–1950).

mum in July and August of a little over 45 percent. Cloudiness, on the other hand, continues to decrease during the same period reaching a low of 16 percent during the month of July. The bars indicating the partly cloudy days do not fluctuate as widely as those showing clear and cloudy skies. In the late fall and winter approximately 26 percent of the days are partly cloudy with the percentage increasing to 40 by June when the maximum is reached. The bar representing average sky cover is based on the percentage of the sky obscured by clouds from sunrise to sunset. The data presented by this bar differ from the bar showing percentage of cloudy days in that it is a combination of cloudy and partly cloudy conditions insofar as the sky is covered by clouds. During the month of December, 71 percent of its skies are covered by clouds accounting for the dark dreary days of that month. The cover decreases steadily until July, when the skies are freest from clouds with only a 40 percent cover.

OTHER PHENOMENA

There are a few minor observations which may be made that do not always enter into climatological reports in such a way that frequency data can be given. This may include such things as fogs, glaze and humidity conditions. A brief treatment of these phenomena will conclude the present paper.

Heavy or dense fog which limits the visibility to one-quarter of a mile or less are not common to the Toledo area. The records show such fogs occur on the average of seven days a year. These are so distributed that an average of one occurs each month from September through April while the other months of the year average less than one-half day per month. Lighter fogs or hazy conditions do occur more frequently but are not as hazardous to street and highway traffic.

During the winter there are occasions when light rains or misty conditions prevail with temperatures which are critically near the freezing point. This results in traffic snarls and many accidents if a coating of ice forms over streets and highways. Usually such accidents are minor as traffic crawls along at a snail's pace. These conditions result in the street department sending out crews of men to scatter salt over the icy surfaces. Accidents are reduced but the salty slush striking the under surfaces of cars causes considerable damage unless protected by undercoating. Much damage comes from the increased weight on utility lines and poles, trees and shrubbery, and other similar objects which may cause breaks or costly repair bills.

Another condition of the atmosphere which affects the individual and his goods in more ways than one, both in summer and winter, is the moisture content of the air. Data are not available on absolute humidity but records have been kept on relative humidity at 6-hour intervals throughout the day for varying periods of time. The 7:30 o'clock readings for the morning and afternoon have been kept for 62 years; the 1:30 P.M. reading for 20 years and the 1:30 A.M. reading for 11 years.

These readings show that the highest annual average occurs at the 1:30 A.M. hour with the air being 82 percent saturated. A small drop occurs between this reading and the one taken at 7:30 A.M. which is four percent less or 78 percent of saturation. A much greater decrease is noted for the afternoon observations. At 7:30 P.M. the air is 68 percent saturated and is 60 percent saturated at 1:30 P.M. This drop for the afternoon hours is to be expected with increasing temperatures.

There is some difference in the time of the year that the relative humidity reaches its maximum and minimum values at these hours. At the 1:30 A.M. hour, August and September have an average high of 85 percent for both months with a low of 78 percent in April. At 7:30 A.M. an average high of 82 percent is recorded for December and a low of 74 percent for May. For the afternoon periods of observation at 7:30 P.M. and 1:30 P.M., the highest monthly average occurs in December with readings of 76 and 71 percent respectively. The lowest averages occur in July with an average of 59 and 52 percent respectively.

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THE EFFECT OF FLOWING WATER ON MORTALITY RATES OF *AEDES AEGYPTI* (L.) LARVAE

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In order to determine the effect of increasing velocities of water and the length of time in these waters on the mortality rates of *Aedes aegypti* (L.) larvae, a series of detailed tests were conducted.

Groups of 25 larvae, five days old, were placed in flowing water and the mortality rate observed at the end of a period of time. This was done for rates of flow ranging from one-half foot per second to four feet per second and for periods of time from four hours to 72 hours. Corresponding to each of these groups, a check group was observed in still water. The experiment was repeated once.

APPARATUS

These tests were run in the "stream-tank" (Sudia, 1951). In addition to the stream-tank, other apparatus was required to provide similar temperature conditions for the control groups. The water bath principle was employed by placing the battery jar used as a control in an aquarium to which was added a 16-inch pencil heater. This heater was controlled by a DeKotinsky Thermo-regulator. A stirring device was added to the aquarium to prevent temperature layering. A Foxboro Recording Thermometer was used to record simultaneously the temperature of the water in the stream-tank and the controls.

CONDITIONS DURING THE TESTING PERIOD

Air temperature. The temperature in the room in which these tests were conducted remained fairly constant at 80±5° F.

Water temperatures. Since the tap water when first introduced to the stream-tank was fairly cool, the equipment was operated for several hours until a stabilized temperature was reached. The water temperature rose to 86° F probably due to the heating effect of the pump. During the operation of the stream-tank over a period of time, the temperature of the water did not vary more than several degrees above or below 86° F. The regulator for the controls was adjusted to provide similar temperatures.

Height of the water level. All tests were conducted with the water level at five inches. The nozzles were set 2.5 inches below the surface of the water.

Measuring the water flow. A Pitot tube was employed to measure the velocity of the water. This apparatus gives readings for the specific point in the stream in which it is placed. The point chosen to take these readings was half the distance from one nozzle around to the other, at a depth of two inches, and two inches from the outer wall of the tank. It is inherent in the design of the stream-tank that the greatest velocity of the water is directly in front of the nozzle and decreases gradually as the water flows toward the second nozzle where it is increased again.

Food. The larvae were fed coarsely ground Purina Checker Dog Chow as needed. Feeding was considered to be nearly equal for both the controls and the

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test specimens because the quantity of food introduced to the stream-tank, based proportionally to the amount of water used, was in slight excess of the amount of food placed in the control battery jar.

METHOD OF CONDUCTING INDIVIDUAL TESTS

The velocity of the water was adjusted to a specific speed and the 25 larvae introduced for a predetermined length of time as 8, 18, 24 hours etc. Another 25 larvae were picked at random from the same source as the test specimens and placed in the control battery jar. After the specified time had elapsed, the larvae were recovered from the stream-tank and the control jar and isolated in pint Mason jars where they were fed and the adults permitted to emerge. All figures presented in table 1 indicate the number of specimens failing to reach the adult stage.

TABLE 1

Number of deaths per group of 25 larvae.

Hours	Experiment A		Experiment B	
	Control	Test	Control	Test
		0.5 ft/sec		
8	4	6	0	5
18	0	9	0	3
24	2	7	3	6
48	1	6	4	10
60	3	11	0	9
72	1	25	1	14
		1 ft/sec		
8	2	3	1	7
18	2	5	1	4
24	0	4	1	5
48	3	9	4	11
60	3	12	1	11
72	0	15	2	19
		2 ft sec		
8	0	11	5	15
24	2	16	1	21
48	1	25	0	25
72	1	25	0	25
		3 ft/sec		
4	2	25	1	25
8	2	25	4	25
24	1	25	0	25
48	4	25	0	25
		4 ft/sec		
4	1	25	0	25
8	1	25	2	25
24	2	25	1	25

STATISTICAL ANALYSIS

Attention is turned to the control groups to see, first, if these groups give any evidence of not being uniform and, second, if the increase of time in water increases the mortality rate.

There was no significant difference between the percentage mortalities for a fixed time interval and there was no significant difference between the percentage

mortalities for different time intervals. The common percent mortality was 5.98 percent; a 95 percent confidence interval for this percent is 4.5 to 7.5 percent. From this it is concluded that the groups of larvae are homogeneous and that the mortality in still water is about 6 percent, for at least the time interval four to 72 hours. In view of these results, the data for experiments A and B were combined. The deaths per group of 50 expressed as a percent are given in table 2.

TABLE 2

Deaths per group of 50 expressed as percent. The numbers in parentheses indicate the limits of a 95 percent confidence interval.

Speed of Current	Time						
	4	8	18	24	48	60	72
0.5		22 (11–36)	24 (13–38)	26 (14–40)	32 (19–46)	40 (26–55)	78 (64–89)
1		20 (12–34)	18 (9–32)	18 (9–32)	40 (26–55)	46 (32–65)	68 (53–81)
2		52 (37–66)		74 (60–85)	100 (92–100)		100 (92–100)
3	100 (92–100)	100 (92–100)		100 (92–100)	100 (92–100)		
4	100 (92–100)	100 (92–100)		100 (92–100)			

TABLE 3

T test for trend.

Speed	T	Probability	Time	T	Probability
½	0	0.001	8	1	0.008
1	2½	0.048	24	1	0.008
2	0	0.042	48	0	0.042

For a given speed of current, the mortality percentages for the extreme times are significantly different. Similarly, for a given time the mortality percentages for the extreme speeds are significantly different. The T test for trend (Mann, 1945) was performed as follows. Using speed 1 as an example, we counted the number of times an element in

20 18 18 40 46 68

was greater than element to the right of it. Calling a tie ½, we get $T = 2\frac{1}{2}$. If the probability of obtaining a $T = 2\frac{1}{2}$ is small (under a random arrangement), it is inferred that a trend exists.

This test was carried out for several speeds and times and the results are in table 3. The data show that for a given speed mortality increases as the time increases, and that for a given time the mortality increases as the speed increases. It is noted that all of the mortality percentages were significantly greater than six percent—the still water mortality.

The times of 50 percent mortality were determined to lie between:

60 and 70 hours for a speed of 0.5 ft./second
60 and 72 hours for a speed of 1.0 ft./second
less than 8 hours for a speed of 2.0 ft./second
less than 4 hours for a speed of 3.0 ft./second
less than 4 hours for a speed of 4.0 ft./second

SUMMARY

A series of tests were conducted to determine the effect of various velocities of flowing water and different lengths of time in these waters upon the larvae of *Aedes aegypti*. Flowing water conditions were obtained in the laboratory by the use of the stream-tank. Additional equipment provided the control larvae with similar conditions except for the substitution of still water for flowing water.

Groups of 25 larvae, five days old, were placed in the stream-tank, and in the control jar where they remained for a predetermined length of time. During this time, they were fed equivalent amounts of food. Upon the termination of this test period, the larvae were recovered and isolated in separate pint jars to continue their development. The mortality rate was based upon the number of larvae failing to reach the adult stage.

It was found that for the times between four and 72 hours, the mortality rate in still water was about six percent, independent of time. However, for water that is flowing, the data show that for a given speed mortality increases as the time increases, and that for a given time mortality increases as the speed increases. The times of 50 percent mortalities are also given.

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Pocket Encyclopedia of Atomic Energy. *Frank Gaynor*, Editor. Philosophical Library, Inc. New York, N. Y. First Edition. 1950. 204 pp. $7.50.

This publication is another of the numerous recent attempts to place a comprehensive collection of the information of nuclear physics in easily digested capsule form for the general public. Convenient features are the alphabetical listings and cross references of some two thousand entries.

The information included covers the elements, radioactive series, units of physics and chemistry, important types of nuclear reactions, information on nuclear research laboratories, and thumbnail biographies of leading nuclear scientists. The following are typical of the tables included in the book: Periodic Table; Stable and unstable isotopes with radiations given off during decay; Nuclear neutron excess as a function of atomic number; Nuclear spin quantum numbers; Reactors in the United States; Sub-atomic particles; Radioactive tracers most widely used in medicine and biology with their principal uses and metabolic properties. The tables also give German equivalents of most terms.

One naturally compares this book with the *Sourcebook on Atomic Energy* which was written by Dr. Glasstone about the same time. The *Sourcebook* presents a more logical, interesting, and readable account of nuclear energy in its present state. The *Pocket Encyclopedia* offers a somewhat more handy means for ready reference since entries are alphabetical. The scope of the *Encyclopedia* is very ambitious for its 204 pages, but the brevity of some entries decreases its value appreciably. However, in general, the information presented is straightforward and in terms such that an unspecialized person can obtain a qualitative idea from most entries.

Reading the book, one gets the impression at times that the author copied his material without sufficient critical scientific editing. Several obvious misprints occur which should have been caught in proofreading.

EDWARD S. FOSTER, JR.

PROTEASE ACTIVITY IN ADULT *AEDES AEGYPTI* MOSQUITOES AS RELATED TO FEEDING[1]

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The importance of mosquitoes as disease vectors is now well established, but much remains to be learned about the fundamental processes of digestion in mosquitoes, especially as they relate to the transmission of these diseases. The studies reported here deal with the stimulation of proteolytic enzyme activity in the adult female yellow-fever mosquito, *Aedes aegypti* L., in relation to the interval of time after feeding and other factors.

METHODS

The *Aedes aegypti* mosquitoes used in these tests were obtained as needed from the colony maintained by an Ohio State University Research Foundation Project sponsored by the U. S. Public Health Service. Female mosquitoes four to six days after emergence were used, since at that age they feed most readily on blood and have, by that time, disposed of any larval food which remained in the midgut at emergence (Fisk, 1950). The insects were transferred to a lamp chimney covered at the top with gauze and resting on a cross-slitted dental rubber dam held in place by an embroidery hoop.

Blood Feeding Techniques

Blood feeding was induced by placing the bare forearm on the gauze over the lamp chimney. The female mosquitoes were attracted to the arm and fed through the gauze. As each one became partially engorged with blood it was withdrawn from below with an aspirator inserted through the cross-slits and placed in a separate three-inch shell vial which was then stoppered with a wad of cotton. The time of feeding for each specimen was noted. After a series of vials had been filled they were transferred to the insectary held at about 80° F and 50 percent relative humidity.

The midguts were dissected from the blood-fed females after a given interval of time had been allowed for normal digestive processes. These time intervals varied from zero to 48 hours as indicated in table 1. Prior to dissection a mosquito was momentarily stunned by a sharp rap of the vial against the palm of the hand. It was then placed on a paraffin covered single concavity slide and decapitated. The midgut was teased from the abdomen and separated from other viscera in a few drops of Levy's mosquito saline. The midguts were accumulated in lots of 20 in a small shell vial resting on ice and containing a drop of chilled saline. The vial was then labelled and placed in a deep freezer at −15° C until needed.

Sugar Solution Feeding Technique

For the sugar-fed series the usual sugar solution and water was withheld from the stock cage the night before. This was necessary to obtain a quick feeding response and to be sure of the proper timing of the feeding. A pledget of cotton saturated with prewarmed 5 percent sucrose solution was placed on the gauze of the lamp chimney. Replete females were removed and placed in individual vials just as with the blood-fed series. Dissections were made just as described for the blood-fed mosquitoes.

[1]These studies were supported in part from funds granted by The Ohio State University Research Foundation to the University for aid in fundamental research.

Injection Technique

A series of mosquitoes was blood-fed and placed in the insectary for from five to twelve hours. Each female was then anesthetized with carbon dioxide gas and its head crushed. With the body on a block of paraffin the abdomen was then carefully teased apart in the region of the fourth or fifth segment. Care was exercised in order not to puncture or break the digestive tract in any way. About 2.5 microliters of Levy's saline was dropped onto the exposed midgut from a ¼ cc tuberculin syringe. The resulting mixture of haemolymph and saline was then picked up by a mouth syringe and injected into a previously anesthetized unfed female *Aedes*. The mouth syringe consisted of a plastic mouthpiece, a small bore rubber tube six inches long, and a three inch long glass tube ending in a fine capillary "needle" tip. The mosquito to be injected was held securely in a specially constructed holder. The injection tip was inserted into the thoracic region at the suture between the meso- and metapleuron and forced posteriorly into the abdomen. As the mixture entered the body the abdomen became noticeably distended. Immediately after injection the mosquito seemed to be in a state comparable to shock, from which it later recovered. Each injected mosquito was placed in a separate shell vial and returned to the insectary for one, two, or five hours after which it was dissected and the midgut removed as previously described. Any mosquitoes which died or which showed injury to the alimentary canal at the time of dissection were discarded. As a check on the technique several mosquitoes were anesthetized, injected with saline, and hours later, dissected.

Enzyme Analysis

Chromophoric protein derivatives are formed by the coupling of diazotized aryl amines with proteins in an alkaline solution. Such azoproteins are completely precipitated by trichloroacetic acid, yielding a colorless filtrate. Digestion of a solution of such proteins by proteolytic enzymes results in the formation of colored components soluble in trichloroacetic acid (Charney and Tomarelli, 1947). The appearance of color in the trichloroacetic acid filtrate depends on an intact, diazotized amino acid or peptide fragment. The intensity of color in the filtrate following protease action is a direct function of the proteolytic activity of the enzyme source and its measurement (as optical density) serves as the basis of this technique.

The substrate, sulfanilimide-azocasein, was first prepared as described by Charney and Tomarelli (1947). A stock solution was then made up to contain 2.5 g azocasein and 0.5 g of sodium bicarbonate per 100 ml. The pH was adjusted to 8.3 and the solution stored at 3° C. The procedure for each enzyme run began with the removal of a vial of 20 dissected-out midguts from the deep freezer. These were homogenized without an abrasive. 1.5 ml of Clark and Lubs standard phosphate buffer, pH 7.8 (Morrow and Sandstorm, 1935), and enough Levy's saline to bring the total volume to 3.5 ml were added to the resulting brei. pH 7.8 has been shown by Fisk (1950) to be optimum for *Aedes aegypti* protease. The mixture was stirred, then 3.0 ml were pipetted into six micro test tubes, 0.5 ml per tube. Two tubes were placed in a boiling water bath while the other four were put into the deep freezer. After 20 minutes boiling, the boiled blanks were placed in the deep freezer with the other tubes until they were approximately the same temperature, (10 minutes). The series then was removed from the freezer and 0.25 ml azocasein substrate added to each tube. The breis were stirred again and placed in a constant temperature bath at 39.6 ± 0.5° C for five hours incubation.

The incubated runs and blanks were removed from the water bath and emptied into six numbered centrifuge tubes, each containing 0.5 ml of 10 percent trichloroacetic acid. Each incubation tube was rinsed into the appropriate centrifuge tube with two more milliliters of trichloroacetic acid. The precipitated protein was separated by centrifuging ten minutes in a Sorvall angle centrifuge at 5500 rpm.

Next, 2.5 ml of supernatant from each tube was transferred to a calibrated Klett colorimeter tube, followed by the addition of 2.5 ml 0.5 N sodium hydroxide to each Klett tube. This shift in pH served to intensify and deepen the color. Optical densities were determined by means of a Klett-Summerson photoelectric colorimeter, using the 440 millimicron blue filter.

The enzyme assay technique was checked by the use of 0.1 percent, 0.01 percent, and 0.001 percent solutions of Coleman-Bell commercial trypsin.

RESULTS

The function of the first series of experiments was to study quantitatively protease activity in the mosquito at various times during digestion of a partial blood meal. The amount of protease activity determined was the amount of

TABLE 1

Data on protease activity of the blood-fed series of Aedes aegypti at various intervals of time after feeding.

Interval of time after feeding	Number of runs	Average optical density	Percent azoprotein hydrolysis	Activity units	Milligrams protein released	Percent efficiency
0–2 min.	4	0.0158	1.16	0.24	0.0253	8.43
5 min. (± 1 min.)	8	0.0068	0.50	0.15	0.0109	3.63
15 min. (± 2 min.)	4	0.0256	1.88	0.57	0.0410	13.33
30 min. (± 3 min.)	8	0.0264	1.94	0.59	0.0423	14.10
1 hr. (± 5 min.)	4	0.0296	2.18	0.65	0.0475	15.83
2 hrs. (± 10 min.)	8	0.1094	8.04	2.47	0.1753	58.43
4 hrs. (± 20 min.)	4	0.2170	16.00	5.09	0.3488	116.27
8 hrs. (± 20 min.)	8	0.4320	31.76	11.18	0.6924	230.80
12 hrs. (± 20 min.)	4	0.5146	37.84	13.91	0.8249	274.97
18 hrs. (± 20 min.)	8	0.6324	46.50	18.30	1.0137	337.90
24 hrs. (± 30 min.)	12	0.5996	44.09	17.01	0.9812	320.40
48 hrs. (± 30 min.)	8	0.3758	27.63	9.46	0.6023	200.77

TABLE 2

Data on protease activity of the sugar-fed series of Aedes aegypti at various intervals of time after feeding.

Interval of time after feeding	Number of runs	Average optical density	Percent azoprotein hydrolysis	Activity units	Milligrams protein released	Percent efficiency
Unfed	11	0.0274	1.99	0.59	0.0434	14.47
5 min. (± 1 min.)	4	0.0296	2.16	0.65	0.0471	15.70
30 min. (± 3 min.)	4	0.0444	3.65	0.96	0.0796	26.53
4 hrs. (± 20 min.)	4	0.0244	1.79	0.52	0.0390	13.00
8 hrs. (± 20 min.)	4	0.0320	2.35	0.70	0.0512	17.07
18 hrs. (± 20 min.)	4	0.0310	2.28	0.68	0.0497	16.57
24 hrs. (± 20 min.)	4	0.0250	1.84	0.54	0.0401	13.37

available protease at the time of dissection, minus losses due to the technique. The amount or condition of the blood meal within the midgut at the time of dissection had no effect on the results since the blood protein would be removed by the trichloroacetic acid precipitation and any soluble colored materials would be equal in both blanks and runs. The results are given in table 1 and figure 1. They show a sharp drop in activity lasting but a few minutes, followed by a steady rise lasting several hours with the peak of activity at 18 hours after feeding. It will be noted that the lowest value obtained was five minutes after a blood meal. This low value is significantly lower than that obtained from unfed mosquitoes.

The amount of protease activity shown by the midguts of unfed mosquitoes shall be referred to as the residual value.

The data for the sugar-fed series (table 2, fig. 1) show an initial increase in activity during the first half an hour. The protease activity then returns to and remains within the range of the residual value. Figure 1 shows that the effect of sugar solution feeding on protease activity is transient and never approaches the stimulation afforded by the adequate substrate, blood. Neither does it cause the initial drop in activity noted with blood. The effect of sucrose feeding on invertase activity was not studied.

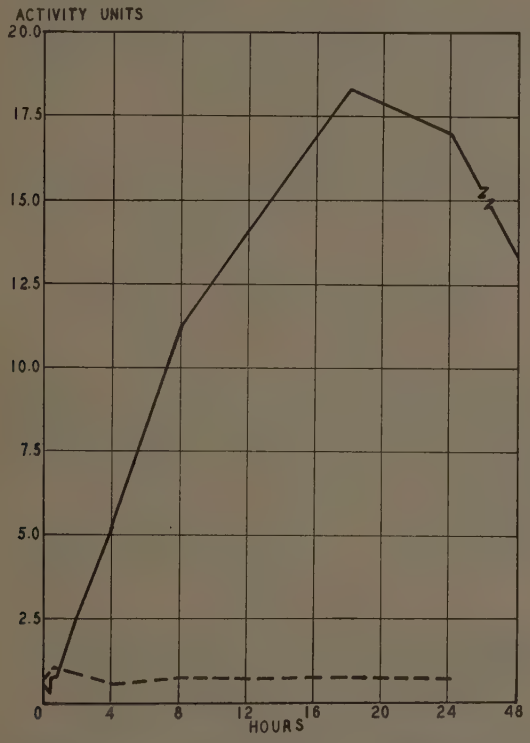

FIGURE 1. Differences in amount of activity of proteolytic enzymes of *Aedes aegypti* at various intervals after feeding on blood or sugar. Solid line: blood-fed mosquitoes; broken line: sugar-fed mosquitoes. Source: Tables 1 and 2.

Basis for Calculation of Activity Units

The readings from the Klett-Summerson photoelectric colorimeter are easily converted to optical densities by multiplying them by 0.002 (Hawk, Oser, and Summerson, 1947). These optical densities can be substituted for protein concentrations as shown by Charney and Tomarelli (1947). The protease activity may then be expressed in terms of the velocity constant, K, of enzyme reactions.

$$K = \frac{1}{t} 2.3 \log \frac{C_1}{C_2}$$

where C_1 is the initial protein substrate concentration and C_2 is the final protein substrate concentration after t minutes of digestion.

The amount of enzyme present may be measured by the "time value" (velocity constant) (Summer and Somers, 1947). The velocity constant is a function of enzyme concentration. In order to compute the velocity constant, the protein substrate concentration must be calculated.

Since an undigested, unprecipitated, and a fully digested sample would give the same color intensity in the final solution to be read in the colorimeter, a blank was run on the dilution of azocasein substrate. This test gave an optical density of 1.36 for the C_1 value or the original protein concentration. This value would correspond then to 100 percent substrate hydrolysis.

The final protein concentration, C_2, is found by subtracting the optical density of the trichloroacetic acid filtrate of each run from the C_1 value. The velocity constant is easily computed after the substitution of the C_1 and C_2 values into the former equation.

Since enzyme activity may be expressed in terms of the velocity constant, enzyme activity of the original midgut contents may be obtained by multiplying the velocity constant by the total dilution factor of the enzyme dispersions, 1:8,749.5. The activity units are arbitrary and are not to be confused with Willstäter units. Percent of substrate hydrolysis is based on the ratio of the optical density of the final solution to the optical density of undigested azocasein (1.36). Activity units and percent hydrolysis are found in tables 1 and 2 and discussed in more detail by Shambaugh (1951).

Factors of Dilution

Assuming the average volume and the average weight of midgut tissue per female to be 0.03 cubic millimeters and 0.03 milligrams, respectively (Fisk, 1950), the milligrams of female midgut tissue per milliliter can be calculated. In our technique there was a ratio of 0.038 midgut per milliliter of final solution in the colorimeter. Multiplying the average value of midgut tissue weight (0.03 mg) by the fraction of midgut in solution gives 0.00114 mg female midgut tissue per milliliter of final solution.

Since there are 25 mg azoprotein in each milliliter of stock solution, there would be 0.82 mg of azoprotein per milliliter of final solution, taking dilution into consideration.

Injection Experiments

In this series of experiments a mixture of saline and haemolymph from blood-fed mosquitoes or saline alone was injected into unfed individuals which were later dissected for enzyme assay. The results as shown in table 3 were completely

TABLE 3

Data on protease activity of Aedes aegypti at intervals of time after the injection of haemolymph of blood-fed individuals into unfed individuals.

Number of runs	Time after feeding	Interval after injection	Average optical density	Percent azoprotein hydrolysis	Activity units
4	check	2 hrs.	0.0240	1.77	0.52
4	5 hrs.	2 hrs.	0.0180	1.32	0.39
4	12 hrs.	1 hrs.	0.0180	1.32	0.39
4	12 hrs.	5 hrs.	0.0156	1.15	0.33
4	15 hrs.	2 hrs.	0.0260	1.91	0.56

negative, that is the protease activity values obtained did not exceed the residual values. The significance of these results will be discussed later.

DISCUSSION

Before discussing the results of the present study it should be pointed out that the work of Fisk (1949, 1950) has provided the starting point for our research. He determined for *Aedes aegypti* the normal pH of the alimentary canal, the source and optimum of pH of the protease, and the fact that protease activity can be demonstrated one to two hours after a blood meal but not after feeding on sucrose solution or in unfed female mosquitoes. The work of Day and Powning (1949) has also provided a strong stimulus to our efforts. They employed modern techniques to study several aspects of digestion in *Blatella*, *Periplaneta*, and *Tenebrio*. Referring to their results they state: "Some of the data . . . are at variance with current concepts and others represent new aspects of the processes of digestion in insects." Their challenging paper points up sharply the lacunae in our knowledge of this field.

The first use of an azoprotein in insect protease studies was by Day and Powning (1949). This technique first tried with duodenal juice (Charney and Tomarelli, 1947) is rapid, accurate, and simple. It is well suited to insect protease studies. In a more recent variation Tomarelli, Charney, and Harding (1949) employ azoalbumin instead of azocasein so that the substrate may be used in both acid and alkaline solutions.

Enzyme Stimulation Following Feeding

Biedermann (1898) was probably the first to note increases in digestive enzymes following feeding. Other authors have noted cyclical changes in midgut epithelium, such as cytoplasmic granule formation or "hypersecretion," presumably due to intensified secretory activity. Day and Powning (1949), however, contend that these changes represent the destruction of the older cells and not secretion. They found the highest enzyme concentrations in the areas of uniform cytoplasm, the so-called "resting epithelium." Actual increases in enzyme activity were noted by Schlottke (1937a, b, c) in *Carabus auratus* (Coleoptera), *Tettigonia cantans* (Orthoptera), *Blatta* (= *Periplaneta*) and *Blatella*. The latter two species were also studied extensively by Day and Powning (1949). The insects just referred to, except the predacious Carabid, are omnivorous feeders in which some food is almost always present in the crop or midgut. All showed:

(a) A decrease in enzyme activity following starvation.

(b) An increase in all enzymes following a brief (10 minute) feeding. The stimulation was not immediate, but clearly evident in half an hour and continued for some hours, (roughly three to eight).

(c) All enzymes were stimulated, irrespective of the food.

(d) There was a marked decrease often below the starvation level, of a given enzyme following a longer (half hour) feeding of its substrate. Depletion of the enzyme by its substrate was cited as the chief cause of this phenomenon.

The results of the present paper and those of Fisk (1950) are based on an insect with entirely different feeding habits. The female mosquito may feed on soluble carbohydrates at frequent intervals but her primary food is blood which, though ingested in a minute or two, may be held for two days or more while it is being digested. For comparison, the results with *Aedes aegypti* may be summarized as follows:

(a) The residual value of protease activity in a blood-starved (e.g. blood-unfed) mosquito is very low. (It was not detected by Fisk, 1950).

(b) A brief feeding (the only type) on blood produced an immediate decrease in protease below the residual value followed by a great increase which was highest at about 18 hours and still evident at 48 hours.

(c) The effect of blood-feeding on other enzymes was not studied, but the effect of sugar solution feeding on trypsin was that of an initial moderate increase noted in the first half hour but entirely dissipated within four hours. Succeeding measurements showed only residual activity.

(d) Continued feeding (½ hour) was not possible with *Aedes*.

Several contrasts are apparent between the results with *Aedes* and with the omnivorous, frequent feeders. For instance, different foods produced different patterns and degrees of protease stimulation. In this connection it may be recalled that in mosquitoes blood and sugar solutions are ingested quite differently, blood going directly to the midgut, while sugar solutions and water go first to the ventral diverticulum or "crop." The high degree and long duration of protease stimulation following a blood meal is another contrast. This pattern cannot be true of all blood sucking insects, however, since preliminary tests in our laboratory with the bedbug, *Cimex lectularius*, showed only a week trypsin-like activity for periods up to 12 hours after feeding.

The initial drop in protease activity immediately following the blood meal may correspond to the depletion of enzyme by its substrate noted by Day and Powning following continued feeding. In their tests the insects were slow to recover from these depletions, while with *Aedes* the "depletion" is made up within half an hour's time despite the continued presence of excess substrate. Schmitz (1938) has described an anti-trypsin in human blood which may temporarily neutralize the mosquito trypsin more rapidly than would be possible by a simple depletion effect.

Mechanism of Enzyme Stimulation Following Feeding

Three possible mechanisms of enzyme stimulation due to feeding have been suggested for insects: (a) secretogogue; the foodstuff itself or its products may chemically stimulate secretion; (b) nervous; the act of feeding, detection of food, or the presence of food may set up a nerve reflex to which the secretory cells will respond; (c) hormonal; like nervous mechanism except that feeding results in production of a hormone which reaches the digestive tract through the haemolymph.

In man all three mechanisms operate in combination but there is no evidence of this in the insects studied. Although Fisk (1950) suggested the possibility of nervous intermediation this seems unlikely in view of the delayed responses noted in every case. Also, Day and Powning have shown that the midgut of *Periplaneta* and the caecae of *Periplaneta* and *Blatella* lacked nerves.

On the basis of simplicity the secretogogue hypothesis would be favored over the hormonal theory, but no direct evidence to support it has yet been given. The injection experiments reported here indirectly favor the secretogogue theory inasmuch as they were designed to confirm the hormonal hypothesis but failed to do so.

The hormonal mechanism is favored by Day and Powning (1949). They point out that the gastric caecae in *Periplaneta* are poorly fitted for the diffusion of food from the gut, but yet they begin to secrete enzymes sooner than the midgut presumably because the hormone flowing back from the head region reaches them first. These authors made injection experiments with both *Periplaneta* and the beetle, *Tenebrio molitor*, in which blood from a fed individual was injected into a starved one and any increases in cell division of the nidi (young secretory cells) noted. Inconclusive data were secured from *Periplaneta* but stimulation was noted in *Tenebrio*. The stimulation was more rapid and more transient than that following feeding but this might be due to the relatively small amount of hormone transferred by the injection. As previously noted, our injection experiments with *Aedes* were all negative.

Quantitative Measurement of Enzyme Efficiency

In order to correlate the efficiency of enzyme solutions under varying conditions with earlier work, it will be necessary to interpret results and reduce them to common terms, to note similarities and differences in technique and enzyme concentration.

Because the enzyme:substrate ratio is quite important to insure enzyme stability and rate of activity up to a point, the weight of protein per midgut per incubation tube was found. Fisk (1949) describes a run having 1 mg protein per midgut per tube. In this study the ratio is 2.18 mg azoprotein/midgut/tube.

Percent efficiency may be calculated by dividing the maximum weight of azoprotein which could be digested by a hypothetical mosquito by the actual amount of azoprotein digested. Assuming that the average mosquito weighs 1.5 mg and ingests its weight in blood (Fisk, 1950) and that whole vertebrate blood contains 20 percent proteins, the maximum amount of protein ultimately ingested is 0.3 mg per midgut. By multiplying the percent hydrolysis of the substrate by the milligrams of azoprotein/midgut/tube (percent hydrolysis X 2.18), one obtains the actual amount of azoprotein in milligrams released per midgut in each test.

Fisk (1949) found an efficiency to be 17.3 percent for one described run using blood as a substrate. This corresponds closely with the percent efficiency secured in our tests for the protease of midguts dissected one hour after feeding.

The highest percent efficiency secured here was apparently 338 percent at 18 hours after feeding. This abnormally high figure may be due to the abnormal enzyme:substrate ratio since more than seven times as much protein was added to the enzyme solution than necessary for maximum digestion. Activity *in vivo* may be limited by the volume of blood the midgut is capable of holding. The high figure may be due to incorrect assumptions, e.g. it is likely that the complete digestion of the blood by a living mosquito requires nearer 48 than 72 hours.

SUMMARY

1. Immediately following a blood meal the protease activity of the midgut of *Aedes aegypti* rapidly drops in 5 minutes to below the residual level characteristic of the unfed mosquito. This may be due to an antitrypsin in the blood or to depletion of the enzyme by the substrate.

2. The drop is followed by an equally rapid increase for the first few hours. The rate of increase gradually falls off but the amount of activity continues to increase until a maximum 26-fold increase is evident at 18 hours. By 48 hours activity is greatly reduced but still above the residual value.

3. In contrast, sugar solution feeding produces an initial two-fold rise in protease activity during the first hour, but by two hours the activity has dropped again to the residual value.

4. These data contrast with those of other authors for other insects in which brief feeding caused an increase in the activity of all digestive enzymes, irrespective of the kind of food taken.

5. The feeding experiments favor either a hormonal or a secretogogue hypothesis of enzyme stimulation, but our injection experiments favor the latter hypothesis.

6. The percent efficiency of substrate hydrolyzed in our tests compared to the estimated rate of a living mosquito digesting a blood meal agrees fairly well with the figure given by Fisk (1950) for one hour after feeding. However our maximum rate (at 18 hours) corresponds to 338 percent efficiency, an unrealistic value.

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Insect Control by Chemicals. *A. W. A. Brown.* John Wiley & Sons, Inc. New York. First Edition. 1951. i+817 pp. $12.50.

This ambitious new book on insect control is characterized by a breadth of coverage and novelty of approach that is a credit to its author. Each of the eleven chapters with its list of references cited covers a separate phase of insect control. The first chapter takes up present-day insecticides, starting with the synthetic organics. The relation of the molecular structure of insecticides to their toxicity comprises the second chapter. The next two chapters are physiological; the susceptibility of insects to the entry of poisons and the pharmacology of insecticides for insects. Chapter five discusses the equipment and methods of applying insecticides, while the following chapter covers applications by aircraft. In both these chapters, the physical principles underlying each method of application are stressed and, in most cases, illustrated with specific quantitative data. The toxicity and hazards of insecticides to man and higher animals are taken up in chapter seven, followed by a chapter on phytotoxicity. Recommended insecticides for use on plant-feeders and on pests of men and animals comprise the next two chapters. Although the discussions of specific recommendations are greatly condensed, a surprising amount of up-to-date information has been included. The final chapter takes up the effect of insecticides on the balance of animal populations. The immediate and ultimate effects on wildlife, beneficial insects, and the pest insects themselves are evaluated. A 37-page index completes the volume.

As a stimulating reference this volume should be of value not only to economic entomologists, but also to insecticide chemists and manufacturers, insect physiologists, and toxicologists, pest control operators, and all those interested in the effects of insect poisons on man and the balance of nature. The discussions are always concise yet the author is able to bring out the essential and unexpected information concerning each topic. If the title of the book is to be taken as its aim, we must conclude that every aspect of the control of insects by chemicals has been touched upon and developed in a workmanlike manner.

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SOME NEW SPECIES OF MEXICAN *DIKRELLA* (HOMOPTERA CICADELLIDAE)

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The genus *Dikrella* was recently erected by Oman (1949) to include a group of minute, delicate *Cicadellinae* previously placed in the genus *Dikraneura*. These differ from *Dikraneura* in having the anterior apical cell of the first pair of wings extending scarcely basad of the base of the adjoining apical cell. *Dikrella* differs from *Kunzeana* in having a posterior apical cell on the first pair of wings which is broader at its base than the combined width of the two adjacent apical cells.

The Mexican fauna contains a large number of species of this genus most of which are undescribed. The following species are the first group of previously undescribed forms from Mexico. Types of all species are in the DeLong Collection.

Dikrella bimaculata n. sp.

Plate I

Resembling *mera* in general appearance, with distinct male genital structures. Length 3 mm.

Vertex: Narrow, produced, and bluntly angled, width between eyes at base about equalling median length. The elytra are long and narrow.

Color: Dull yellowish without markings except at apex of elytra. The elytra are marked with a round black spot on anterior apical cell which is near base and on costal margin. The posterior apical cell has a round black spot at about its middle.

Genitalia: The male pygofers are broad with their apices nearly truncate. Short, slender, bent pygofer hooks arise on the dorso-caudal angles of the pygofers. The anterior margin of the valve is truncate with its posterior margin convexly produced on its median half. The plates are broad and separated at their bases. A pair of heavy, short spines arise on the proximal third of the lateral margins of the plates. The styles are broad with their apical margins serrate and their mesal apical lobes long and curved. The connective is Y-shaped and thick. The base of the aedeagus is short and slender with its dorsal processes long and moderately thick. A pair of parallel, long, thin ventro-lateral processes arise on the base and extend dorsad to near the apices of the pygofer. The phalicata is slender and nearly parallel sided. A pair of thin ventro-lateral processes arise at the base of the phalicata and extend to near its distal third.

Holotype male collected at Chilpancingo, Gro., October 25, 1941 by Good and DeLong.

Dikrella nigrinota n. sp.

Plate I

Resembling *bimaculata* in general form but smaller and with distinct genitalia. Length 2.5 mm.

Vertex: Rather strongly produced and angled, a little longer on middle than basal width between the eyes.

Color: White tinted with yellow. Elytra yellowish subhyaline with a large round black spot in the anterior apical cell and another in the posterior apical cell.

Genitalia: Female seventh sternite with posterior margin broadly roundedly produced. Male pygofers broad with their apices rounded. Flat elongate processes, bifurcate at their apices, arise on the inner walls of the pygofers and extend to the apices of the pygofers. The anterior margin of the valve is truncate with its posterior margin convexly produced on its median half. The plates are broad and widely separated at their bases. A pair of stout spines arise near the middle of the lateral margin of each plate. The styles appear swollen near their apices and their mesal apical lobes are long and curved. The connective is nearly T-shaped and broad. The base of the aedeagus is short and broad and bears two pair of processes, a pair of long, appressed processes ventrad to the phalicata and a pair of shorter, diverging processes borne on a thin shaft dorsad to the phalicata.

Holotype male, allotype female, and male and female paratypes collected at Chilpancingo, Gro., October 25, 1941 by DeLong and Good.

Dikrella mella n. sp.

Plate I

Resembling *bimaculata* in general form and appearance but with distinct male genitalia. Length 3.5 mm.

Vertex: Produced and bluntly angled, as long at middle as basal width between the eyes.

Color: White tinged with yellow which is condensed on the median portion of the vertex and in two irregular longitudinal stripes across pronotum. Elytra subhyaline with yellow veins. The anterior and posterior apical cells each containing a large round black spot.

Genitalia: Female seventh sternite with posterior margin forming a pair of short rounded median lobes and a rounded more produced lobe next each lateral margin. Male pygofers elongate, with their apices produced into sharply pointed projections, the ventral edges of which are thickened. Short, spine-like pygofer hooks arise on the dorso-caudal angles of the pygofers. The valve is truncate on its anterior margin and convex on its posterior margin. The plates are narrow and widely separated at their bases, a pair of stout spines arise near the middle of the lateral margin of each plate. The styles are broad with their lateral apical lobes broad and relatively long and with their mesal apical lobes long, thin, and curved. The connective is Y-shaped with its arms broad. The base of the aedeagus is long and cylindrical. It bears two pairs of processes, a pair of long appressed processes ventrad to the phalicata, and a shorter diverging pair dorsad to the phalicata.

Holotype male and paratype male collected at Cuernavaca, Mor. (K. 57), October 21, 1941 by DeLong, Good, Caldwell, and Plummer. Allotype female and female paratype collected at Iguala, Gro., September 11, 1939 by Plummer and DeLong. Female paratypes from Rancho Monter, Oax., December 14, 1937 (M.F. 3639), collected by Dampf; and paratype female from Vergel, Chis., May 22, 1935 (M.F. 4259) Dampf.

Dikrella angustella n. sp.

Plate I

Resembling *bimaculata* but with vertex more bluntly angled and with distinct male genitalia. Length 3.5 mm.

Vertex: Produced and bluntly angled, about one-fourth wider between eyes at base than median length. Pronotum decidedly wider than vertex.

Color: Pale yellowish, unmarked except for three spots on elytra. The three spots are round and pale. One is near the base of the anterior apical cell, another is near the base of the posterior apical cell, and a third is anterior to the cross veins of the third apical cell.

Genitalia: Female seventh sternite with posterior margin broadly rounded and produced. Male pygofers rounded at their apices and without hooks. The anterior margin of the valve is concave while its posterior margin is convexly produced on its median half. The plates are rather broad and separated at their bases with their apices upturned and rounded. The styles are moderately heavy with their mesal apical lobes long and thick and their lateral apical lobes short and sharply pointed. The connective is U-shaped and thick. The aedeagus is thick and cylindrical and tapers from near its middle to its narrowed, rounded apex. A pair of long, curved, lateral processes arise at the apex of the aedeagus and extend laterad.

Holotype male, allotype female, and female paratypes from San Jacinto, D.F., July 4, 1932. Female paratype from Mexico City, D.F., June 12, 1924 and female paratype from San Cristobel Las. Casas Chis., July 9, 1926, all collected by Dr. Dampf.

Dikrella venella n. sp.

Plate I

Resembling *angustella* in form and general appearance but without color markings and with distinct male genital structures. Length 3 mm.

Vertex: Bluntly angled about one-third wider between eyes at base than median length. Pronotum decidedly wider than head.

Color: White rather uniformly tinged with yellow, elytra subhyaline, veins yellow.

Genitalia: Female seventh sternite with posterior margin strongly produced and bluntly angled. The male pygofers are long with their apices extended into short, sharp spines. Tapering, sharply pointed pygofer hooks arise on the dorso-caudal angles of the pygofers. The valve is truncate on its anterior margin and convex on its posterior margin. The plates are contiguous at their bases and angulately produced on the basal quarter of their lateral margins. The styles are unique in *Dikrelli*, their apical portions being extended into foot-shaped lobes. The connective is Y-shaped with its shaft short and broad. The base of the aedeagus is long and broad with its dorsal processes long and slender. The phalicata is broad, parallel sided, and obliquely truncate apically. A pair of broad, flat, apically notched lateral processes arise on the apex of the phalicata.

Holotype male and allotype female collected at Zitacuro, Mich. (Km 160), Sept. 29, 1941 by DeLong, Caldwell, Plummer, and Good.

Dikrella albidula n. sp.

Plate I

Resembling *bimaculata* in general appearance, white in color and with distinct male genitalia. Length 2.5 mm.

Vertex: With apex rather broad and blunt, about one-fourth wider between eyes at base than median length. Pronotum a little wider than head.

Color: White, the elytra with a large round black spot in the anterior apical cell, and another in the posterior apical cell.

Genitalia: Male pygofers broad, with their apices nearly truncate. Thin, curved pygofer hooks arise on the dorsal-caudal angles of the pygofers. The anterior margin of the valve is sharply concave with its posterior margin convexly produced on its median third. The plates are broad and narrowly separated at their bases and taper to rounded apices. The styles are deeply, roundly notched on the apical third of their lateral margins. The mesal apical lobes of the styles are long and thin with their lateral apical lobes thick and pointed. The connective is Y-shaped and thick. The base of the aedeagus is short and thick with its dorsal processes long and slender. A pair of long, recurved, ventro-lateral processes arise on the base, cross each other near their bases and extend laterad. The phalicata is broad, nearly parallel sided, and truncate at its apex.

Holotype male and paratype males collected at Iguala, Gro., Sept. 11, 1939 by Plummer and DeLong.

Dikrella aureocosta n. sp.

Plate II

Resembling *bimaculata* in form and general appearance, pale in color and with distinct male genitalia. Length 2.5 mm.

Vertex: Bluntly angled about one-fourth wider between eyes at base than median length.

Color: White faintly tinted with yellow. Abdomen bright yellow, Elytra subhyaline, costal vein yellow, other veins white.

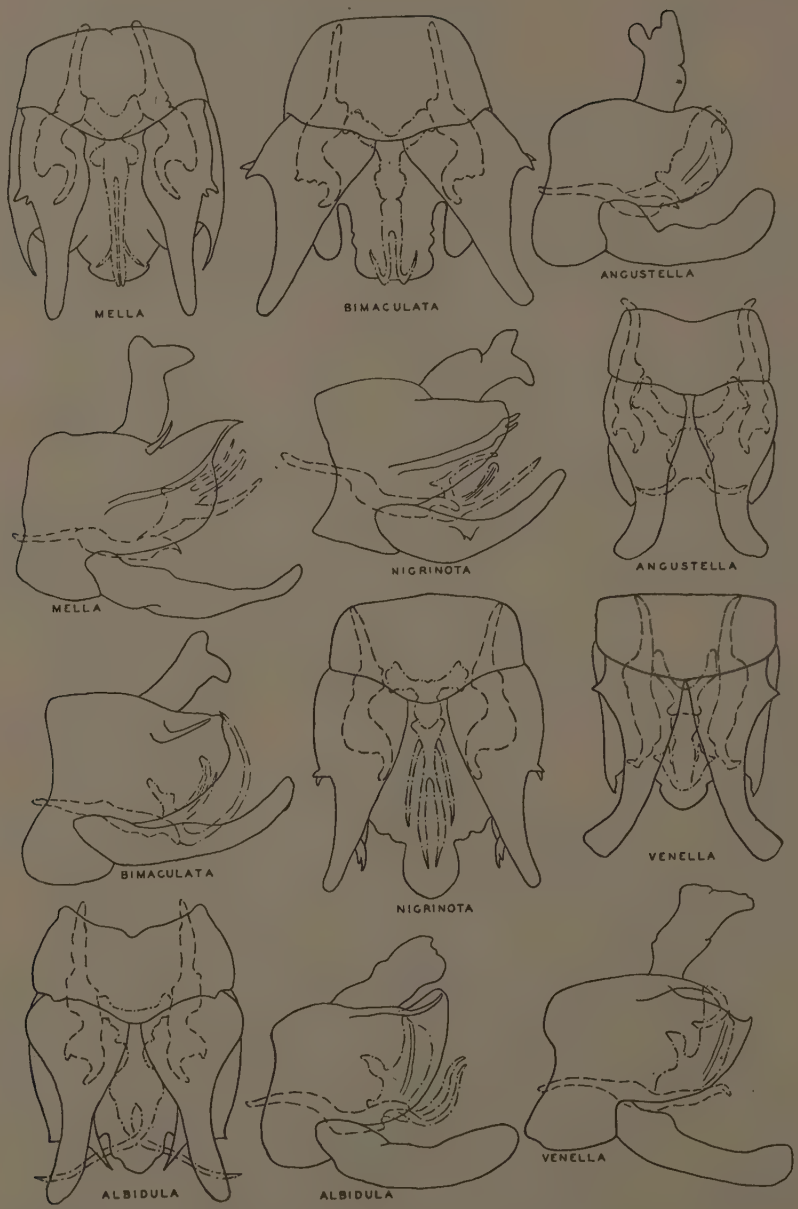
Genitalia: Male pygofers broad with their apical margins truncate. Short, sharply pointed spines arise at the apices of the pygofers and tapering, pointed pygofer hooks arise on their dorso-caudal angles. The anterior margin of the valve is truncate with its posterior margin convexly produced on its median third. The plates are broad and separated at their bases with their apices rounded. The styles are broadly, roundedly notched near the apical third of their lateral margins and their mesal apical lobes are long and slender. The connective is Y-shaped and slender. The base of the aedeagus is short and slender with its dorsal processes long and rather thick. A pair of long, recurved ventro-lateral processes arise on the base and extend dorsad above the apex of the pygofers. The phalicata is long, slender, and rounded at its apex.

Holotype male and male paratypes collected at Iguala, Gro., Sept. 11, 1939 by DeLong and Plummer.

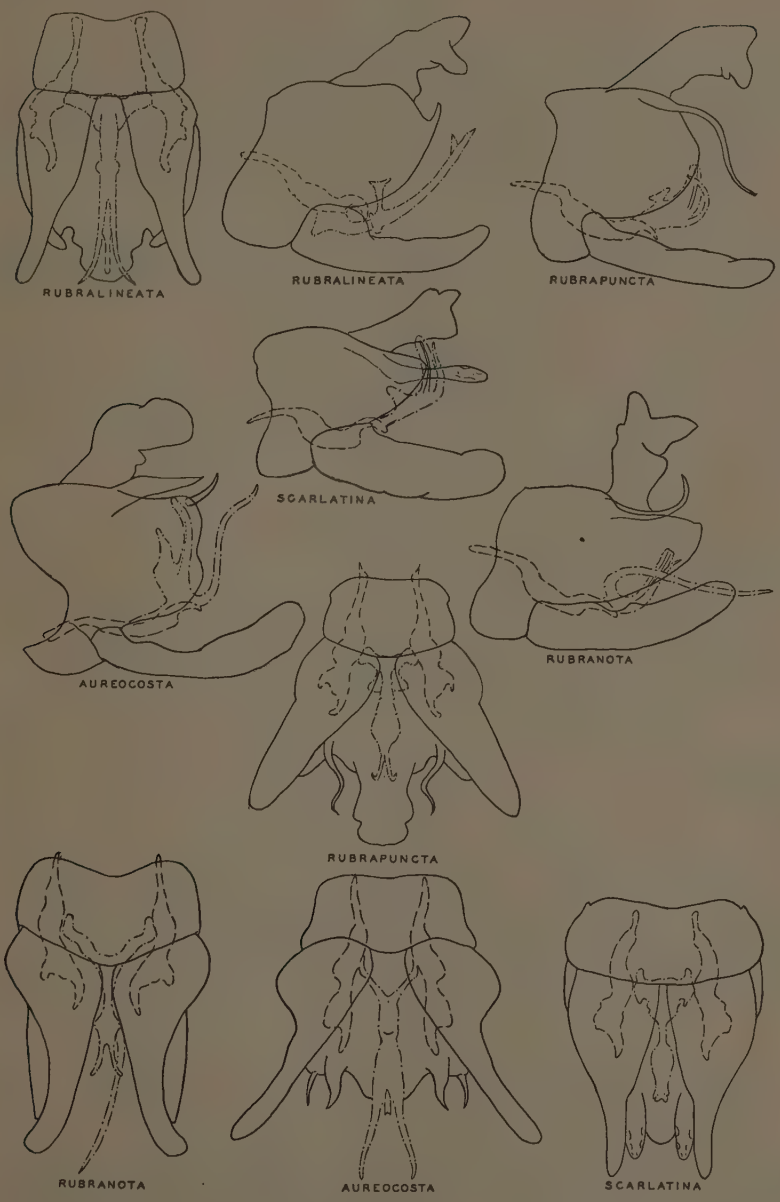
Dikrella rubralineata n. sp.

Plate II

Resembling *bimaculata* in general form with a blunter head, two red lines on vertex and pronotum, and with distinct male genitalia. Length 2.7 mm.



The figures are illustration of the ventral and lateral views of the male genital structures.



The figures are illustration of the ventral and lateral views of the male genital structures.

Vertex: Bluntly angled, a little wider between eyes at base than median length. Pronotum decidedly wider than head.

Color: White, a pair of broad longitudinal orange bands extending from each side of apex of vertex across vertex, near eyes, pronotum and onto base of scutellum. An orange spot at apex of scutellum. Elytra with large orange reddish spots on clavus. The basal spot is elongate, the other three or four are more rounded. The costal and corium areas of the elytra have a series of small, bright red, circular spots scattered from base to apex, usually about nine in number, two near base along costa, three about middle of wing between costa and corium, three in a row before apical cross veins and one on second apical vein. Face yellow with an orange spot next each eye.

Genitalia: Male pygofers broad, with their apices produced into sharp, nearly erect points. The posterior margin of the valve is almost truncate while its anterior margin is concave. The plates are narrow and separated at their bases with their apices narrow and blunt. The styles are moderately broad with their lateral apical lobes short and blunt and their mesal apical lobes elongate and narrow. The connective is T-shaped, with its arms curving ventrad. The base of the aedeagus is short and cylindrical with its dorsal processes long and thin. A pair of long, flat, lateral processes arise on the base and sheath the thin, elongate phalicata for most of its length.

Holotype male and paratype males collected at Iguala, Gro., Sept. 11, 1939 by Plummer and DeLong; male paratypes from Chilpancingo, Gro., Oct. 25, 1941, Good and DeLong; El Mante Tamaul, Oct. 26, 1930 (M.F. 1775) Dampf; Vejuco, Gro., Sept. 3, 1930 (M.F. 1790) Dampf, and Mezcala, Gro., Jan. 13, 1929 (M.F. 1513) J. Parra.

Dikrella rubrapuncta n. sp.

Plate II

Resembling *rubralineata* in form and general appearance but paler in color and with distinct male genital structures. Length 2.5 mm.

Vertex: Blunt, rounded at apex, about one-fourth wider between eyes at base than median length. Pronotum wider than head.

Color: White, vertex with a pair of rather broad yellowish lines extending from apex of vertex across vertex, pronotum, and the basal angles of scutellum. A yellow spot on the apex of the scutellum. Elytra subhyaline tinged with yellow. A small round red spot at apex of clavus and a series of four on the medius vein. A few are found irregularly on the corium or apical cells.

Genitalia: Male pygofers short and broad with their apical margins rounded. Thickened, oblique folds divide the pygofers into pigmented basal portions and hyaline apical portions. Long, thin, recurved pygofer hooks arise on the dorso-caudal angles of the pygofers. The anterior margin of the valve is nearly truncate with its posterior margin convex. The plates are rather broad and separated at their bases with their apices narrow and bluntly angled. The styles are broad with their mesal and lateral apical lobes long and pointed. The connective is Y-shaped with the base of its shaft produced into a broad, flat dorsal lobe. The base of the aedeagus is long and thick with its dorsal processes short and broad. A pair of thin ventro-lateral processes arise on the base and curve dorsad to near the apex of the broad, apically rounded phalicata.

Holotype male and male paratypes collected at Iguala, Gro., Sept. 11, 1939 by DeLong and Plummer; male paratype from Mezcala, Gro., Aug. 4, 1930 (M.F. 1735), collected by J. Parra.

Dikrella scarlatina n. sp.

Plate II

Resembling *mera* in general form with vertex more pointed, brightly marked with red and with distinct male genitalia. Length 2.7 mm.

Vertex: Strongly produced and bluntly pointed. A little longer at middle than basal width between the eyes. Head as wide as pronotum.

Color: White, vertex with an elongate, reddish spot on disc between the eyes. Pronotum with a rather broad, reddish curved band parallel to the anterior margin and protruding to the margin on each side between the eyes. A large red spot on apex of scutellum and a fainter spot in each basal angle. Elytra with an elongate reddish spot on the clavus at the base. A spot on the middle of each clavus, a reddish spot on corium and a diagonal reddish band extending

backward from costa at about two-thirds the length of elytra which terminates on the middle. Each elytron with a black spot on inner basal portion of posterior apical cell. Face yellowish with a broad red band interrupted at middle, a little below margin and between the eyes.

Genitalia: Female seventh sternite with posterior margin broadly angularly produced. The male pygofers are elongate and bluntly angled at their apices. The thick pygofer hooks arise on the dorso-caudal angle of the pygofer and appear somewhat clavate. The margins of the valve are almost truncate. The plates are broad and narrowly separated at their bases. The styles are broad with their mesal apical lobes long and curved dorsad. The connective is broad and T-shaped. The base of the aedeagus is long and cylindrical with its dorsal processes long and moderately thin. A pair of thin, ventro-lateral processes arise on the base and are closely appressed to the long, parallel sided phalicata to near its apex.

Holotype male, allotype female and female paratype collected at Chilpancingo, Gro., October 25, 1941 by DeLong and Good.

Dikrella rubranota n. sp.

A blunt headed species with one red spot on each elytron and with distinct male genitalia. Length 3 mm.

Vertex: Short, blunt, rounded in front, about one-third wider between eyes at base than median length. Head narrower than pronotum.

Color: White tinted with yellow. Elytra subhyaline, coastal margin broadly yellow. A bright red elongate spot just above costal margin and about two-thirds the distance from the base.

Genitalia: Male pygofers elongate, with their apices bluntly angled. Thin, dorsally curved pygofer hooks arise on the dorso-caudal angles of the pygofer. The anterior margin of the valve is concave with its posterior margin convex. The plates are broad and separated at their bases. The styles are widened toward their apices and their apical lobes are rather long. The connective is Y-shaped and thin. The base of the aedeagus is short and bears three processes, a pair of short, thin ventro-lateral processes and a single, long, caudally directed, dorsal process.

Holotype male and male paratype from Popotla D.F., June 19, 1924 (M.B. 68) and male paratypes from D.F. without specific data all collected by Dr. Dampf.

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Oman, P. W. 1949. The Nearctic Leafhoppers. Ent. Soc. Wash. Mem. 3, 83 pp.

Biometric Analysis. *Alan E. Treloar.* Burgess Publishing Co. Minneapolis, 1951. v+251 pp. $4.50.

Textbooks on statistical methods for students of the life sciences may be classified in various ways: those that are either too mathematical or not sufficiently so; those in which either the classical methods of statistical analysis and description or the newer methods are slighted; and those that are either primarily an introduction (and so of little use to the research worker who wants a dictionary of methods) or a handbook (and so of little use in a classroom). This book by Dr. Treloar is an introduction to the classical methods of statistical description and analysis, requiring algebra as a background.

The publication includes excellent expositions of the methods of measuring location and variability of continuous and discrete variables, of the proportions and ratios used in vital statistics, and of the methods of correlation and regression. The concepts and practices of statistical tests of significance are given for the cases which may be handled by use of the normal, t, and χ^2 distributions. Uses of the binomial, Poisson, and normal distributions as models of biological variables are also described and illustrated.

The book does not include a description of the analysis of variance (which, as the author points out, would require a large addition to the text), general procedures and concepts of the theory of estimation, nor a discussion of the concept and use of "power of a test" in testing statistical hypotheses.

E. L. Green

SOME NEW MYXOPHYCEAE FROM SZECHWAN PROVINCE, CHINA

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During a ten-year period (1937–1946) of collecting algae in the mountainous Szechwan Province of China, the writer secured several new species of *Myxophyceae*. Six of these were collected from Mt. Omei in August, 1942, and have already been described (Chu, 1944). Additional collections from different localities in the province have brought to light other apparently undescribed *Myxophyceae*. In this paper one genus, five species and two varieties are considered as new to science; two species have been placed in a genus other than the one in which they were originally described. They all belong to the phylum *Myxophyta*, class *Myxophyceae*, order *Chroococcales;* the first six described in the paper are in the family *Chroococcaceae* and the remaining three in the *Entophysalidaceae*.

1. **Chroococcus limneticus** Lemm. var. **multicellularis** Chu var. nov.
Figures 5, 6

Cellulae sphericae ad semisphericae, 4–128 vel plures in communi involucro gelatinoso, spherico, pyramidali quadratove; vagina lata, non lamellata, 4–8–16 cellulae plerumque confertae et in latiroe vagina gelatinosa, globosa, cinceracea subpurpureave inclusae; 8–16 coloniae vicissim in matris vagina gelatinosa inclusae; cellulae 5–9μ diam., intus pallide aut nitide caeruleo-virides, homogeneae.

Cells spherical to semispherical, 4–128 or more in a common spherical, pyramidal or quadrate gelatinous envelope; sheath wide, not lamellated, 4–8–16 cells generally lying close together and enclosed in a wider ball-shaped pale-gray or pale-purple gelatinous sheath; 8–16 colonies in turn enclosed in the mother gelatinous envelope; cells 5–9μ in diameter; cell contents pale to bright green, homogeneous.

The chief distinctive characteristics of this variety are: (1) the special colonial sheath of each small group of cells in the mother colony is more or less distinct and (2) numerous small colonies are enclosed in the original sheath.

This alga was found in a stony pool at the bank of a rapid stream, Helungkiang, in Omei-Shan, Szechwan. The plant was attached to leaves and stems of hydrophytic macrophytes. Collection date: Aug. 28, 1941.

2. **Gloeothece fusco-lutea** Naeg. var. **unilamellaris** Chu var. nov.
Figure 4

Cellulae vagina primaria unilamellari tectae, vagina secondaria typicae plantae (*G. fusco-lutea*) carente; cellulae cylindricae, plus minusve oliveformes, extrematatibus subrotundatis, 4.0–6.5 x 5.2–7.2μ sine vagina, 4.6–6.8 x 7.2–8.0μ cum vagina, intus pallide caeruleo-virides.

Cells covered by a single-layered primary sheath, no secondary sheath as in the species proper; cells cylindrical, more or less olive-shaped with slightly rounded ends, 4.0–6.5 x 5.2–7.2μ without sheath, 4.6–6.8 x 7.2–8.0μ with sheath; cell contents pale blue-green.

This variety differs from the type species in two ways: (1) rounded ends and wider dimensions of cells and (2) one-layered sheath. Collected on wet stones submerged in a rapid stream on Mt. Kingfu, Szechwan, Aug. 24, 1944.

3. **Aphanothece lemnae** Chu sp. nov.
Figure 7

Planta endophytica in spatiis intercellularibus *Lemnae* sp. (*L. trisulca?*); massa plantae spherica ovatave, involucro gelatinoso lato, incolorato, 68–80μ (interdum usque ad 160μ) diam. inclusa; cellulae oblongae cylindricaeve, extremitatibus rotundatis, plerumque binae vel quaternae (aut interdum singulae), ab aliis intra vaginam coloniae aliquantum remotae; cellulae 3.2–4.4

x 4.2–6.8μ; vagina singula omnino confluens, raro apparens; cellulae intus homogeneae, pallide caeruleo-virides.

Plants endophytic in intercellular spaces of species of *Lemna* (*L. trisulca?*); plant mass spherical or ovoid, enclosed in a wide colorless, gelatinous envelope, 68–80μ (occasionally up to 160μ) in diameter; cells oblong or cylindrical with rounded ends, generally in groups of two or four (or sometimes solitary), separated a considerable distance from other groups of cells inside the colonial sheath; cells 3.2–4.4 x 4.2–6.8μ; individual sheath completely confluent or very occasionally present; cell contents homogeneous, pale blue-green.

This species differs from *A. nidulans* Richt. v. *endophytica* W. & G. S. West by its larger size and the ordinary two- or four-celled groups separated from other groups at considerable distances. It also differs from *Gloeocapsa magma* (Breb.) Kuetz. in its endophytic habit, its colorless sheath, the small size of its cells and the complete confluence of its individual sheaths. Collected in an artificial pond in Chengtu, in early August of 1940.

Asterocapsa Chu gen. nov.

Massa plantae grumosa, gelatinosa, olivaceo-viridis, flava ad lutean aut pallide caerulea; cellulae sphericae oblongave, 2–4–8–16 vel plures in involucro crasso, vaginato, lamellato aut non lamellato, non confluente; inclusae vagina coloniae crassissima, rigida, lamellas confluentes in involucri margine habens, incolorata aut flava aut punicea, plerumque adulta fuscescens; superficies vaginae cellularum singularum atque involucri coloniae proiectionibus verruciformibus, brevis longisve, minutis crassisve, perfusa; cellulae intus homogeneae aut minute granulatae (pseudovacuolae?), olivaceo-virides, nitide caeruleo-virides auto fusco-virides, in 2–3 plana divisae.

Multiplicatio per divisionem vegetativam aut per fragmentationem coloniae, necnon per aplanosporas facta.

Plant mass grumose, gelatinous, olive-green, yellow to golden brown or light blue; cells spherical or oblong, 2–4–8–16 or more cells enclosed in the thick-sheathed envelope, lamellated or not, not confluent; colonial sheath very thick, stiff, with confluent lamellae at the margin of the envelope; sheath colorless, yellow or pink, becoming mostly yellowish brown with age; surface of sheath of both individual cells and the colonial envelope covered by short or long, minute or stout wart-like projections; cell contents homogeneous, or finely granulated (pseudovacuoles?), olive-green, bright blue-green or brownish green; cell division in two or three planes. Multiplication by vegetative division or fragmentation of the colony; aplanospores present.

Members of this genus differ from the related genus *Gloeocapsa* chiefly by the wart-like projections on both individual cell-sheath and colonial envelope, by the spherical shape of the mature colonies and by the non-confluent lamellae of the individual cells. Three species of this new genus have been found in the mountainous regions of Szechwan. The type species is designated as ***Asterocapsa gloeotheceformis*** Chu.

KEY TO THE SPECIES

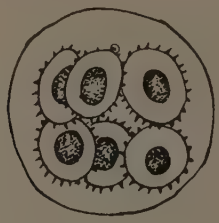
1. Cells oblong ..... *A. gloeotheceformis*
1. Cells spherical 2
   2. Cells 2.5–3.6μ in diameter, without sheath ..... *A. hyalina*
   2. Cells 10–13μ in diameter, without sheath ..... *A. trochiscioides*

4. **Asterocapsa gloeotheceformis** Chu sp. nov.

Figures 8, 9

Massa, plantae grumosa, crustacea, gelatinosa, olivaceo-virides; cellulae binae, quaternae vel octonae in vagina lata, incolorata puniceave, lamellata inclusae; coloniae paucae aut multae vicissim matris involucro gelatinoso, pallide subflavo, spherico oblongove, marginaliter confluente tectae; cellulae oblongae, aut per compressionem mutam angulatae; proiectiones verriciformes in vaginae superficie breves, basibus latioribus, numerosae, per omnem superficieme involucri fere perfusae; cellulae 7–9 x 12–16μ; coloniae 70–250μ diam.; cellulae intus homogeneae aut minute granulatae (pseudovacuolae?), caeruleo-virides.

Plant mass grumose, crustaceous, gelatinous, olive-green; cells 2–4–8 in groups enclosed in a wide colorless or pinkish lamellated sheath; few to many small colonies in turn covered by a very wide, pale yellowish gelatinous envelope, spherical or oblong, or angled under mutual compression;



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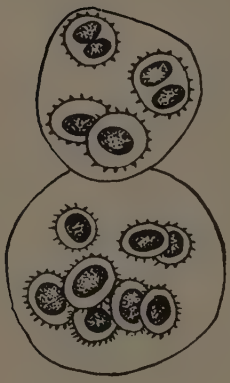

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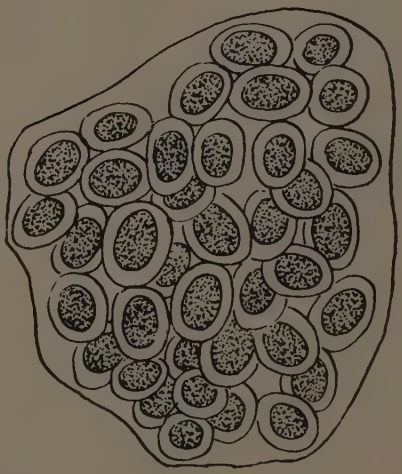

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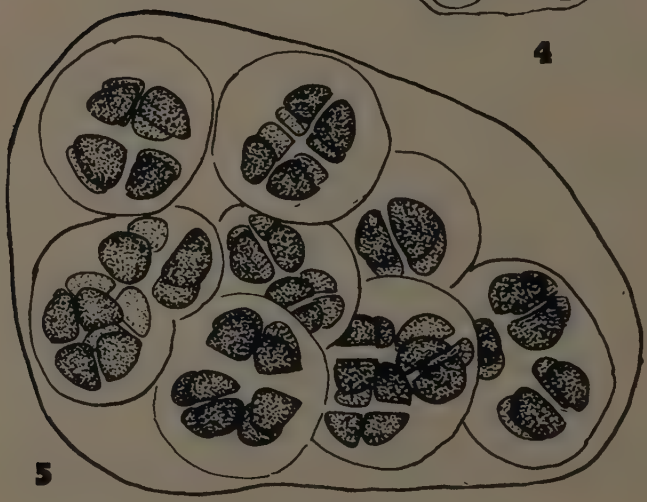

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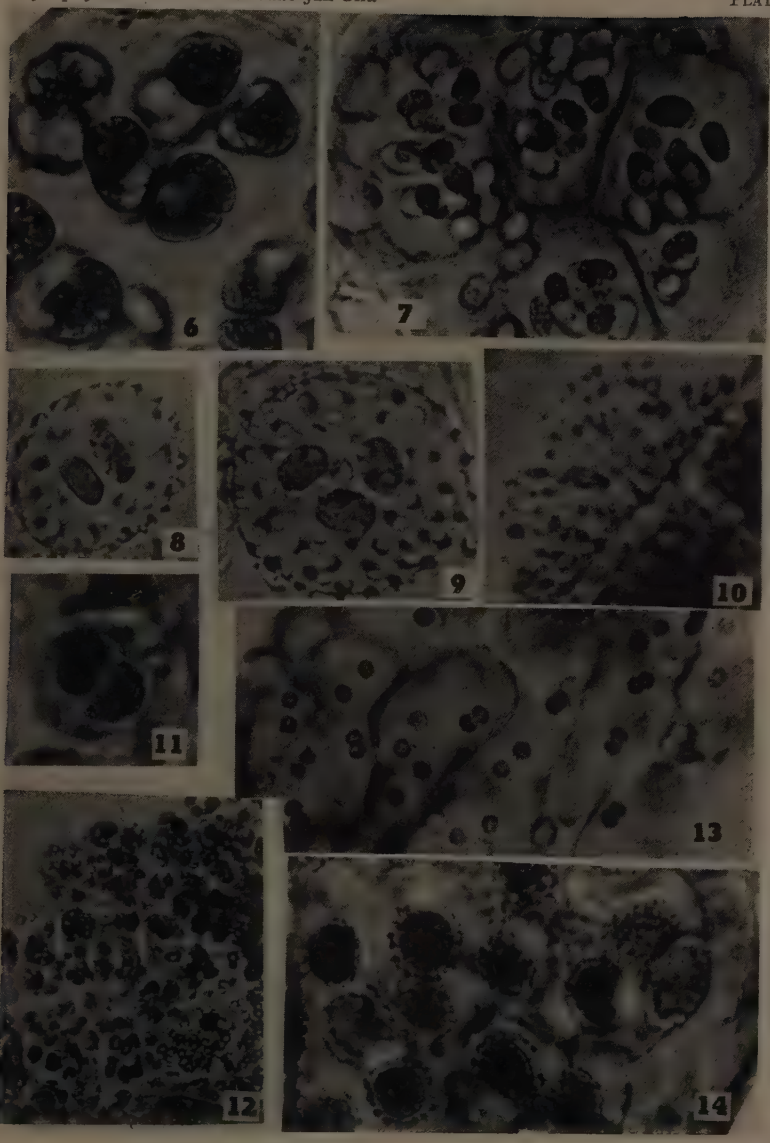

EXPLANATION OF FIGURES IN PLATES I AND II

1–3. *Asterocapsa hyalina* (Chu) Chu comb. nov.
4. *Gloeothece fusco-lutea* Naegeli var. *unilamellaris* Chu var. nov.
5, 6. *Chroococcus limneticus* Lemmermann var. *multicellularis* Chu var. nov.
7. *Aphanothece lemnae* Chu sp. nov. Colony inside host tissue in intercellular spaces.
8, 9. *Asterocapsa gloeotheceformis* Chu sp. nov. (8) two-celled colony, (9) surface view of four-celled colony showing wart-like projections.
10. *Chlorogloea sinensis* Chu sp. nov. A cluster of the thallus.
11, 12. *Cyanostylon sinensis* Chu sp. nov. (11) cells with stalks, (12) habit sketch.
13. *Entophysalis robusta* Chu sp. nov. Part of colony showing arrangement of branches.
14. *Asterocapsa trochiscioides* (Jao) Chu comb. nov. Small part of a large colony.

wart-like projections on the surface of the sheath soft, short, with widened bases, numerous, and nearly covering the whole surface of the envelope; cells 7–9 x 12–16μ; colonies 70–250μ in diameter; cell contents homogeneous or finely granulated (pseudovacuoles?), blue-green.

This alga was found on wet surfaces of caves and rocks and cliffs under dripping water at an altitude between 2000 and 3500 meters in Mt. Omei and Mt. Kingfu.

5. **Asterocapsa hyalina** (Chu) Chu comb. nov.
Figures 1, 2, 3

Anacystis hyalina Chu. Sinensia 15: 153–158. 1944.

This alga was collected from wet rocks, cliffs, under dripping waters of old caves and falls, at altitudes of 1000–2500 meters in mountainous regions of the Province. It is generally mixed with other Chroococcaceae and with species of *Nostoc*, *Scytonema*, *Stigonema* and others. It is smaller than either of the other two species of the genus.

6. **Asterocapsa trochiscioides** (Jao) Chu comb. nov.
Figure 14

Anacystis trochiscioides Jao. Sinensia 15: 1–32. 1944.

This species grows on wet rocks of caves, and rocks and cliffs under dripping water at altitudes of 1000–3000 meters in the mountainous southwestern and southeastern parts of Szechwan. It is very wide-spread, distributed from Kwangsi Province northward through Kweichow to Szechwan and perhaps also westward to Yunnan Province.

It is felt that the last two species have characteristics that associate them with the newly described genus *Asterocapsa*. They are therefore removed from their doubtful assignment to the genus *Anacystis*.

7. **Cyanostylon sinensis** Chu sp. nov.
Figures 11, 12

Massa plantae crustacea, grumosa, mollis, caeruleo-viridis; cellulae sphericae, hemisphericae, oblongae aut ellipsoideae, in cacuminibus cauliculorum gelatinosorum, brevium, crassorum, incoloratorum sitae, 2.5–6.8μ diam., singulae binaeve, aut (forsan modo post divisionem?) ternae vel quaternae; vagina incolorata aut aliquantulum cineracea, perspicue aut inperspicue lamellata; lamellae firmae, vix aut haud confluentes, 2–3 strata circum omnem cellulem formantes; cum duae, tres vel quattuor cellulae cacumini uni adsunt, in vagina communi, unum vel duo strata habente, includuntur; cauliculus cylindricus, pyriformis aut irregularis, lamellas inperspicuas.

Plant mass crustaceous, grumose, soft, blue-green; cells spherical, hemispherical, oblong, ellipsoid, situated at the tips of short, stout, colorless gelatinous stalks, 2.5–6.8μ in diameter; unicellular or in groups of two, three or four, the latter two cases perhaps just after division; sheath colorless or slightly pale green, distinctly or indistinctly lamellated; lamellae firm, non-confluent, or somewhat confluent forming two to three layers around each cell; if two, three or four cells are present on the same tip, they are enclosed by a common one or two-layered sheath; stalk cylindrical, pyriform or irregular, with indistinct lamellae; cell contents homogeneous or granulated, brownish olive-green or bright blue-green.

This species grows on wet rocks under dripping water and on rocks submerged in artificial ponds in Omei-shan at an altitude of about 1200 meters. Collected in August, 1941.

8. **Entophysalis robusta** Chu sp. nov.
Figure 13

Massa plantae grumosa, crustacea, rubro-brunnea aut purpureo-brunnea; usque ad 250–400μ diam.; cellulae sphericae, plerumque binae vel quaternae, interdum singulae; vagina crassa, rubro-purpurea aut rubra, non lamellata; pseudofilamenta brevia crassaque; cellulae 3.5–4.5μ diam., sine vagina, intus homogeneae aut tenuiter granulatae, maxime caeruleo-virides; vagina coloniae 6.8–8.0μ diam.

Plant mass grumose, crustaceous, reddish brown to purplish brown, up to 250–400 μ in diameter; cells spherical, generally two or four cells in a group, sometimes unicellular; sheath thick, reddish purple or red, non-lamellated; pseudofilaments short, stout, with cells 3.5–4.5μ in

diameter, without sheath; cell contents homogeneous or finely granulated, deep blue-green; colonial sheath 6.8–8.0μ in thickness.

This alga was found on wet rocks mixed with *Gloeocapsa*, *Chroococcus*, *Schizothrix* and other blue-green algae at the entrances to deep caves, Kingfu-shan, Nanzechwan, in August, 1946.

9. Chlorogloea sinensis Chu sp. nov.

Figure 10

Massa plantae epiphytica, gelatinosa, hemispherica aut lamelliformis, usque ad 25–40 x 50–80 (—100)μ; coloniae vagina gelatinosa, delicatula, dissolvente tectae; vagina cellulae deest; cellulae a basali parte thalli radiatim ordinatae, ordinibus parte in superiore interdum dichotome ramosis; cellulae sphericae, oblongae aut ellipsoideae, 1.2–2.2μ diam., intus olivaceo-virides aut pallide caeruleo-virides, homogeneae.

Plant mass epiphytic, gelatinous, hemispherical or plate-like, up to 25–40 x 50–80 (—100)μ; colonies covered by a delicate, dissolving gelatinous sheath; individual sheath wanting; cells arranged radially from the basal part of the thallus, sometimes dichotomously branched at the upper part; cells spherical, oblong or ellipsoid, 1.2–2.2μ in diameter; cell contents olive-green, pale blue-green, homogeneous.

This new member of the entophysalidacean blue-green algae somewhat resembles *C. tuberculosa* (Hansg.) Wille. The new species differs, however, in the size of the plant mass, in having distinctly dichotomous branches (especially at the tip), and in its freshwater habitat. It was found growing epiphytically on *Chantransia*, mixed with *Dermocarpa*, *Chamaesiphon* and diatoms; the host plant was attached to rocks of an artificial dam—"Flower Stream"—in South-Hot-Spring Park, Chungking, in December, 1944.

The writer wishes to express his gratitude to Dr. Hannah Croasdale for her kindness in supplying the Latin translations of the diagnoses.

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Physical Chemistry for Premedical Students. *John Page Amsden.* McGraw-Hill Book Co., New York. Second Edition. 1950. 317 pp. $4.25.

This publication is the second edition of a text prepared for use in a one semester physical chemistry course for premedical students. It includes a very brief and simplified presentation of only those phases of physical chemistry which the author believes are most valuable to the medical student: the states of matter (including colloids) and their properties, solutions and their properties, chemical equilibrium and speed of reaction, thermodynamics, and oxidation and reduction. The content of the book is too limited to provide a satisfactory training in physical chemistry for students preparing for research in biological fields. However, the material which has been included should provide instructive and most interesting reading for the average premedical student.

The major changes made in the preparation of the second edition are the inclusion of a brief chapter on thermodynamics and a complete revision of the discussion of protolytic equilibrium. The book is well organized and written. Sample problems with detailed solutions illustrate each new concept introduced in the text. Each chapter is followed by additional problems suitable for homework assignments. Demonstration and instruction aids for the teacher are given throughout the book. The author presents many desirable examples of the application of physical chemical principles in the explanation of physiological processes which clearly indicate the importance of a working knowledge of physical chemistry to the premedical student.

The reviewer agrees with the author in his claim that a course in physical chemistry belongs in the program of the premedical student. Realizing that the program is already crowded with required courses, the author therefore limited the material as much as was consistent with an adequate presentation of the elementary principles of the subject.

JACK G. CALVERT

THE USE OF ANTIBIOTICS FOR OBTAINING BACTERIA-FREE CULTURES OF EUGLENA

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Preliminary to studies of the physiology of *Euglena gracilis*, we attempted to obtain bacteria-free cultures of a clone isolated by Professor W. J. Kostir and maintained in the Protozoology Laboratory of the Ohio State University. Attempts to obtain bacteria-free cultures using the established technique of washing a few individuals in successive baths of sterile distilled water were not always successful and the procedure proved to be time consuming.

The difficult problem of obtaining bacteria-free protozoan cultures is now being attacked by the utilization of antibiotics. Reported investigations (Mahmoud, 1944; Morgan, 1946; Seaman, 1947; and others) have indicated success with penicillin and with streptomycin. However, because of the extensive studies of antibiotic resistance of bacteria (Miller and Bohnhoff, 1950), it appears highly improbable that the reported studies of protozoan isolations with single antibiotics or simple combinations represent a true sampling of the likely antibiotic resistances that may be expected.

Goodwin (1950) reported obtaining bacteria-free cultures of *Euglena gracilis* with the use of penicillin alone, and in combination with dihydrostreptomycin. Our attempts to repeat this work with the Kostir clone were unsuccessful.

MATERIALS AND METHODS

Stock clone cultures of *Euglena gracilis* have been maintained in 0.04 percent peptone (Arlington Chemical Co., Yonkers, N.Y.) solution in a one-to-one mixture of distilled and well-water. However, since this medium was found to be inadequate for maintaining euglena growth in the absence of bacteria, Hall's (1937) medium for pure (bacteria-free) cultures was used. This medium consists of: 0.5 gm of KNO_3, 0.5 gm of KH_2PO_4, 0.25 gm of $MgSo_4$, 0.1 gm of NaCl, a trace of $FeCl_3$, 5.0 gm of tryptone, and 1.0 liter of distilled water. A standard inoculum of the contaminated euglena culture was used, consisting of a single loopful containing 30–40 actively swimming euglenas.

Various combinations of the readily obtainable water-soluble antibiotics—penicillin, dihydrostreptomycin, aureomycin and bacitracin—were tried in an attempt to obtain bacteria-free cultures of *E. gracilis*. These antibiotics were added in varying concentrations and combinations to 10 ml of a three-week-old contaminated euglena culture. No bacteria-free cultures were obtained, possibly because of the large number of bacteria present. Bacitracin was found to be slightly toxic at all the concentrations used and therefore was abandoned.

When a standard inoculum of the source culture was streaked out on blood agar and on nutrient agar, two types of colonies were isolated. The one colony contained small Gram-negative rods while the other, a much larger colony, contained Gram-positive rods. No attempts were made to identify the contaminants further. Finding both Gram-positive and Gram-negative organisms indicated that in order to obtain pure cultures with antibiotics, a wide antibacterial spectrum would have to be provided.

Rather high concentrations of the antibiotics were used in order to make sure that the amount present was greater than the minimal effective concentration

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required for antibacterial action. Epps, Weiner, and Bueding (1950) successfully obtained bacteria-free cultures of *Ascaris lumbricoides* by using combinations of 1000 units per ml of penicillin, 200 micrograms per ml of aureomycin, 100 units per ml of bacitracin, 500 micrograms per ml of streptomycin, and 1.2 mg per ml of sulfadiazine. This concentration of sulfadiazine was found to be toxic to *Euglena gracilis* and was omitted in addition to bacitracin. In our final experiments the above concentrations of the antibiotics used were doubled. The antibiotics were diluted with sterile culture medium to obtain the desired concentrations in a final total of 5 ml of medium. Culture tubes, 15 by 85 mm were used. Table I summarizes the combinations and quantities of the antibiotics tested.

The experiment was conducted at 23 degrees Centigrade, and under fluorescent lighting of 220 foot-candles illumination for 14 hours a day. After 10 days the sterility of the cultures was checked by Gram-stained smears, by subculture into thioglycollate broth (a specified medium for the testing of sterility), and by direct microscopic examination of wet mounts. To test the viability of the euglenas, the test material was also inoculated into sterile euglena culture medium.

TABLE 1

Combinations and quantity of antibiotics tested.
μg = micrograms, u = units.

Culture	1	2	3	4	5	6	7
penicillin	2000 u/ml			2000 u/ml		2000 u/ml	2000 u/ml
dihydro-streptomycin		1000 μg/ml		1000 μg/ml	1000 μg/ml		1000 μg/ml
aureomycin			400 μg/ml		400 μg/ml	400 μg/ml	400 μg/ml

RESULTS

The bacterial resistances to the antibiotics are summarized in table 2. In the control culture, containing no antibiotics, Gram-positive and Gram-negative rods were found, with the Gram-positive rods in preponderance. In culture 1, containing penicillin, a preponderance of Gram-negative rods was present, but there were also noted a few unevenly stained, Gram-positive, long filamentous rods. There was a change in the morphology and the staining reaction of these Gram-positive rods. These changes were probably due to the action of penicillin, and indicated that the organisms were damaged to a certain extent. In culture 2, containing dihydrostreptomycin, no Gram-negative rods were found, but heavy growth of Gram-positive rods occurred. In culture 3, containing aureomycin, both Gram-positive and Gram-negative rods were present. In culture 4, containing penicillin and dihydrostreptomycin, some Gram-positive rods were found in filamentous arrangement. In culture 5, containing dihydrostreptomycin and aureomycin, only some Gram-positive rods were found. Culture 6, with penicillin and aureomycin, showed the presence of Gram-negative rods only. In culture 7, in which all three antibiotics were present, *no bacteria were found.*

After a period of 10 days, the control and test cultures, 1, 2, and 3, showed no viable euglenas. This may be explained by the more rapid and dense growth of the contaminating bacteria in Hall's medium, which has more than a ten fold increase of organic material over the peptone medium previously used.

In evaluating the viability of *Euglena* in cultures and sub-cultures from cultures 4, 5, and 7, the numbers of euglena after ten days growth was found to be approximately 4 percent of that of culture 6, which was the only one of this series of cultures not containing dihydrostreptomycin. The euglenas did not show any loss of chloroplasts in those cultures containing 1000 micrograms per ml of dihydrostrep-

tomycin, contrary to the results obtained by Provasoli, Hutner, and Schatz (1948). Perhaps this discrepancy may be accounted for by the fact that the culture medium contained no carbohydrates and that those cells that did bleach died soon after bleaching. This may account for the small number of organisms in cultures 4, 5, and 7, as compared with culture 6.

TABLE 2

Results of tests of bacterial resistance to antibiotics.

G+ = *Gram-positive*, G— = *Gram-negative.*

Culture	G+	G—
control	+	+
1 (penicillin)	+	+
2 (dihydrostreptomycin)	+	
3 (aureomycin)	+	+
4 (pen. and dihydrostrep.)	+	
5 (dihydrostrep. and aureo.)	+	
6 (pen. and aureomycin)		+
7 (pen., dihydrostrep., and aureomycin)		

CONCLUSIONS AND DISCUSSION

Penicillin, dihydrostreptomycin, aureomycin, bacitracin, and sulfadiazine were added, both singly and in combinations, to a clone culture of *Euglena gracilis* in attempts to obtain bacteria-free cultures. Successful pure (bacteria-free) cultures were obtained by the use of penicillin, dihydrostreptomycin, and aureomycin in combination. Bacitracin and sulfadiazine were found to be toxic to the *Euglena gracilis* strain tested.

Since both Gram-positive and Gram-negative bacteria were present, obtaining bacteria-free cultures proved to be more difficult than was the case in previously reported studies, except possibly for the study of Williams and Plastridge (1946). Indeed it is difficult to understand the success obtained in earlier studies using a single antibiotic unless factors other than antibiotic action were utilized. From the details of these reports it is difficult to judge what these factors might be, but it appears probable that in some cases at least (Seaman, 1947) washing out some of the bacteria during the isolation procedure may have played an important role.

In the development of antibiotic techniques for obtaining bacteria-free cultures it would certainly be profitable to exploit such methods as washing out at least some of the contaminating bacteria. The numbers of bacteria can also be controlled by such conditions as incubation temperature, inoculum size, pH (Zumstein, 1900), and organic content of the medium. Although the value of these methods has been recognized for some time, it is our own experience from these studies that by themselves they may not be adequate and that the use of antibiotics provides a valuable tool for obtaining bacteria-free protozoan cultures.

ACKNOWLEDGMENTS

This study was supported in part by Project 323 of the Ohio State University Research Foundation, sponsored by the Procter and Gamble Co., Cincinnati, Ohio, during January to March, 1951, when this study was done. The authors wish to express their appreciation to Miss Bernice Levine for her technical assistance.

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Fundamentals of Organic Chemistry. *James Bryant Conant, Albert Harold Blatt.* Macmillan Company, New York. 1950. ix+413 pp. $4.00.

The authors of this book set as their objective the presentation of organic chemistry for students planning to enter a vocation connected in one way or another with applied biology. A broader purpose is expressed in the secondary motive of describing organic chemistry in the world of today in terms of its proper place in an industrial society such as ours and in terms of the products and the raw materials.

To make it possible to achieve these additional objectives in presumably a one-semester course, considerable compression must be exerted on the conventional curriculum of organic chemistry. The compression has been done very well in what is probably the only feasible way: the most notable eliminations are in discussion of mechanisms of reactions, reaction rates, and equilibria. The classic topic of organic colors is reduced to a total of several pages of description, interspersed in the discussion of aromatic compounds at points at which the intermediates or related compounds are encountered.

As usual, special chapters are devoted to polyhydric alcohols: fats and oils, stereoisomerism, carbohydrates, amino acids and proteins, and heterocyclic compounds; and in all of these, the emphasis is placed on biochemical interpretation. The secondary objectives of the authors are most definitely accomplished in the following admirable chapters: "Gasoline and Rubber," "Industrial and Laboratory Syntheses," "Biochemical Processes," and "Natural and Synthetic Drugs." Industrial organic chemistry is treated mainly as their objective would require, in terms of the raw materials and the needs of our technology.

In the field of synthetic medicinals, the classic "cut-and-try" exploratory method is described, but then in the discussion of drug antagonism in the sulfa drugs, the explanation in terms of enzyme complexes is brought out and thus a possible rational basis of chemotherapy. Indeed, the biochemical thread of enzyme chemistry runs through all these discussions, in connection with vitamins, drugs, carbohydrate and protein metabolism, and alcoholic fermentation. The cumulative effect of these presentations is to make the student aware of the place of organic chemistry in all of these fields—in terms of present achievement and in terms of the promise of valuable results in the investigation of as yet unsolved problems.

This text then consists of first an able presentation of the structural concepts of the most important chemical reactions in organic chemistry. The further discussion of the application of this basic knowledge in industrial and biological problems is carried out in such a way that the authors' secondary objectives are very effectively achieved. The place of the book is in a course for non-chemistry majors. With acceptance of the philosophy that students in the fields of applied biology can profit through increased interest and from a biochemical slant to the subject matter, this book is highly recommended.

EARL W. MALMBERG

AN ADDITION TO THE OHIO RECORDS OF MILLEPEDES

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One hundred or more specimens of a small, barbed-haired millepede were collected on November 9, 1950, from beneath the bark of a sycamore tree adjacent to the farm campus of Ohio State University by Mr. John Knierim. On November 12, 1950, the author visited the described site and collected several dozen more specimens of the same species. This same site was collected again on May 12, 1951, when two or three dozen immature specimens were taken.

The author's tentative identification indicated that these specimens were *Polyxenus fasciculatus* Say, 1821. (The author is indebted to Dr. R. A. Hefner of Miami University for verification of his tentative identification). A complete description of the genus and American species is given by Williams and Hefner (1928), while the more interesting features of this millepede are shown in figure 1.

FIGURE 1. Dorsal view of a slide-mounted specimen of *Polyxenus fasciculatus* Say. Line at lower right indicates actual length.

The living individual is about one-eighth inch in length and is basically of a light tan color with many white to cream colored bristles. Contrasting sharply with this tan background are two dense, linear masses of light colored caudal bristles which show up even to the naked eye as a small white patch. This white appearance of the caudal area is a distinctive field characteristic.

Most of the colonies found by the author were about an inch in diameter and consisted of approximately one hundred individuals. The colonies were found beneath the closely adhering deciduate bark of the sycamore, and might easily have been overlooked had it not been for the numerous, white cast skins in the vicinity of each colony.

Because these collections appear to be the first of this genus and species in Ohio, and since it appears to be permanently established in this one location at least, specimens will be placed in the Department of Zoology Collection of Miami University, Oxford, and the Ohio State Museum, Columbus.

REFERENCE

Williams, S. R., and R. A. Hefner. 1928. The Millepedes and Centipedes of Ohio. Bulletin 18, Ohio Biological Survey.

BOOK NOTICES

Lectures in Abstract Algebra, Vol. 1. Basic Concepts. *Nathan Jacobson.* D. Van Nostrand Company, Inc., New York. 1951. xii+217 pp. $5.00.

This is the first volume—*Basic Concepts*—in a projected series of three, the other two being subtitled *Linear Algebra* and *The Theory of Fields and Galois Theory*. This book is clearly written in an economical style which usually requires the active participation of the reader. Most proofs are succinctly presented and exercises occur frequently. The book is well-suited as a text for a graduate course in modern algebra. In the following the titles of the chapters are given and parenthetically their content or important topics: Introduction: concepts from set theory (a brief summary), the system of natural numbers (postulates and elementary properties). Semi-groups and groups (including factor groups, homomorphisms). Rings, integral domains and fields (ideals, homomorphisms). Extensions of rings and fields (fields of fractions, polynomials, simple extensions). Elementary factorization theory (principal ideal and Euclidean domains). Modules and ideals (Hilbert basis theorem, Noetherian rings, prime and primary ideals. Lattices (Boolean Algebras).

LEONARD TORNHEIM

Textbook of Inorganic Chemistry. *J. R. Partington.* Macmillan and Co., Ltd., London. Sixth Edition. 1950. x+996 pp.

The new edition of this well-known textbook continues in the tradition of previous editions in both format and style. The sections on atomic structure and electronic theory of valency have been extended, and new sections on directed bonds and resonance added. Sections on pH, hydrolysis, titration, indicators, buffer solutions, and modern theory of electrolytes have been added to the chapters on chemical equilibrium and the sections on rarer elements considerably extended. The questions given in previous editions have been omitted.

The book is sound as to content. However, it seems to the reviewer that the inclusion of so much historical material and of actual experimental details makes the book needlessly extensive in terms of the material presented. Furthermore, an unimaginative style of writing, dull format, and poor illustrations make the book unattractive and, to a high degree, soporific. The author makes little use of electronic, molecular, and crystal structures in explaining the properties of substances and ignores much of the chemistry of the last three decades. For example, he does not mention in the chapter on water such items as hydrogen binding, molecular structure of water, structure of ice, or the explanation for the abnormal properties of water. The book still follows the traditional Mendeleeff periodic chart. This book is of value to teacher and student as a source of descriptive data of inorganic chemistry.

HARRY H. SISLER

Southeast Asia. *E. H. G. Dobby.* John Wiley & Sons, Inc., New York. First Edition. 1951. 415 pp. $5.00.

This publication not only fills in a serious gap in English geographic studies of the Asiatic Realm but appears at a critical period in the affairs of southeastern Asia. The author, professor of geography at the University of Malaya, Singapore, states his purpose as follows: "The aim of this book is to present a picture of environmental conditions and human adaptations in Southeast Asia which shall provide the student with a basic text and at the same time stimulate the sociologist, the administrator, the politician and the businessman to see the relation of their work to the general field." Such an aim is commendable but perhaps a bit too ambitious, especially as regards those individuals engaged in business, administration, or political enterprises.

The text, divided into three parts, "The Natural Landscape of Southeast Asia," "The Countries of Southeast Asia," and "The Human Geography of Southeast Asia," is a storehouse of information. Through the author's method of presentation one feels his intimacy with the land and its people. Some questions must be raised however regarding the order of the several political divisions and the somewhat inconsistent arrangement of materials; also the overemphasis on Malaya and Burma, even though both may be of special interest to the writer.

Numerous charts, sketch maps, and tables add much to the desirability of the book, but no information has been given to the sources; proper crediting should have been considered. The addition of major topographic features to the general end paper maps would be of great assistance to the reader. Unfortunately, a good informative sketch map was not provided for each political division; the value of such a series of maps should not have been overlooked. Photographs, common to most American geographic publications, are lacking. The bibliography is a worthwhile contribution and should prove highly useful to those interested in a more intensive study of Southeast Asia.

CURTIS M. WILSON

Hormone Assay. *C. W. Emmens* (Ed.). Academic Press, Inc. New York, N. Y. 1950. vii+556 pp. $10.00.

The rapidity in the increase of knowledge of hormones is apparent when one considers the vast amount of material pertaining to this field which has appeared in the past decade. Until this book was published, no reference was available which adequately presented the methods for the quantitative determination of these important substances. This volume fills the need. Although usable as a text, its nature will cause it to be widely used as a reference and as a manual.

Under the editorship of C. W. Emmens, eighteen well qualified persons have contributed to the publication. Each section describes the specific methods available for the quantitative determination of certain hormones. The latest and more accurate methods available for all of the hormones in question are stressed; each method is precisely and thoroughly described. In addition, the editor has added a brief, understandable chapter on the use of statistics in biological and chemical assay.

The book is not light reading, nor was it intended to be. For the person interested in hormones, or for the research worker in endocrinology or physiology, this collection of assay methods should be a valuable addition to his library.

EDWARD F. GODFREY

The Housefly, Its Natural History, Medical Importance, and Control. *Luther S. West.* Comstock Publishing Company, Ithaca. 1951. xi+584 pp. $7.50.

The first chapter entitled "Flies and Men," presents an interesting historical sketch of how man became aware of the dangers and hazards of the house fly to human health. This is followed by a series of chapters which contain thorough discussions of the morphology, physiology, and behavior of the house fly, its life-history, taxonomic status, and geographical distribution. Several of the ecological requirements such as food, temperature, humidity, and light relationships, and the inter-relationship of the fly with parasites, predators, symbionts, and commensals are then presented.

The author next introduces the house fly as a menace to public health, and its relationship to human disease, stressing particularly myiasis and the transmission of typhoid fever, cholera, bacillary dysentery, diarrhea, anthrax, conjunctivitis, tuberculosis, leprosy, plague, and virus diseases.

One chapter is devoted to a treatment of the fly as an experimental animal especially in insecticidal testing work, and to the discussion of field, museum, and laboratory techniques.

The latter part of the book deals with control measures such as garbage disposal and the newer insecticides, with emphasis upon the uses and dangers of DDT.

This well-written book contains an abundance of excellent illustrations and a comprehensive bibliography. It should be of value as a reference book especially in connection with public health training and medical entomology and could serve as a manual in specific courses in either of these fields of work.

DWIGHT M. DELONG

The Reptiles of Ohio. *Roger Conant.* The American Midland Naturalist. University of Notre Dame, Notre Dame, Indiana. Second edition, 1951. xxxviii+284 pp. $3.50.

The first edition of this work was published in 1938 (see excellent review: J. W. Price. Ohio Jour. Sci., 1938, 38: 334). Dr. Price's statement of the need for this work has been proven by its continued demand. Contemplating a second edition, the editors were faced with producing (1) a sweeping revision or (2) a reproduction of the 1938 text with a revisionary addenda. Wisely, the latter was chosen, thereby keeping the revision within the price range of most of us.

The Revisionary Addenda portion of 84 pages includes a brief introduction, data accumulated since 1938 on 4 lizards, 27 snakes, and 10 turtles, 3 pages of additional bibliography, and 12 plates. Two forms, the subspecies *Opheodrys vernalis blanchardi* and the species *Thamnophis radix radix*, have been added. The many changes in the scientific names made since 1938 are adequately explained in the text under each form. Problems created by referring to two widely separated accounts of a species are largely solved by having these two key references in bold type in the Index. The new data are excellently presented with few typographical errors. The new maps bring the Ohio distribution of each species to date.

This book makes an important contribution to our knowledge of Ohio reptiles, and is a valuable reference work for those interested either in Ohio vertebrates or in the herpetology of Midland America.

MILTON B. TRAUTMAN